Special Features On High Fidelity

OCTOBER 1959

Radio-Electronics

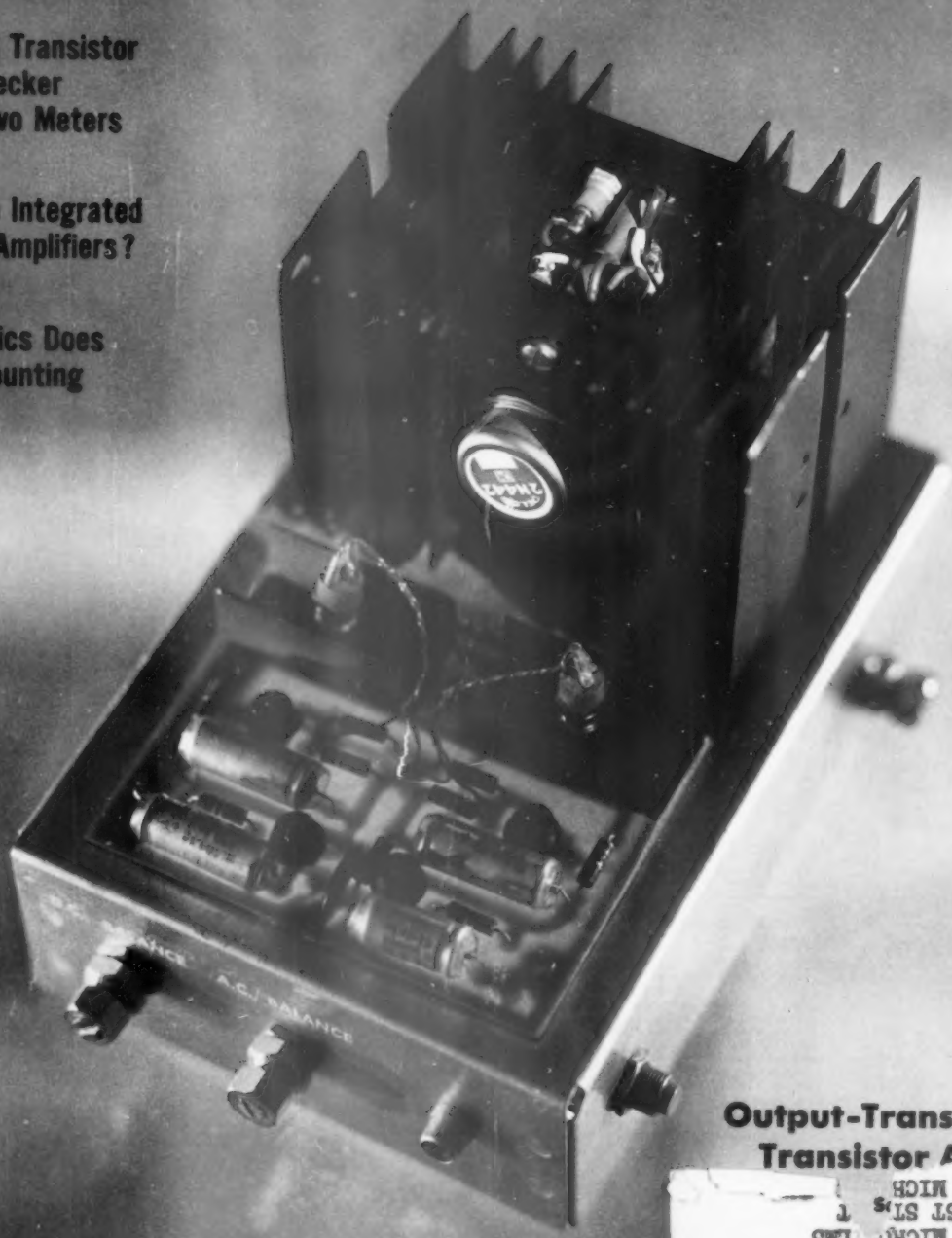
HUGO GERNSBACK, Editor

35c

Improved Transistor Checker Uses Two Meters

Why Use Integrated Stereo Amplifiers?

Electronics Does the Counting



Output-Transformerless Transistor A~ r

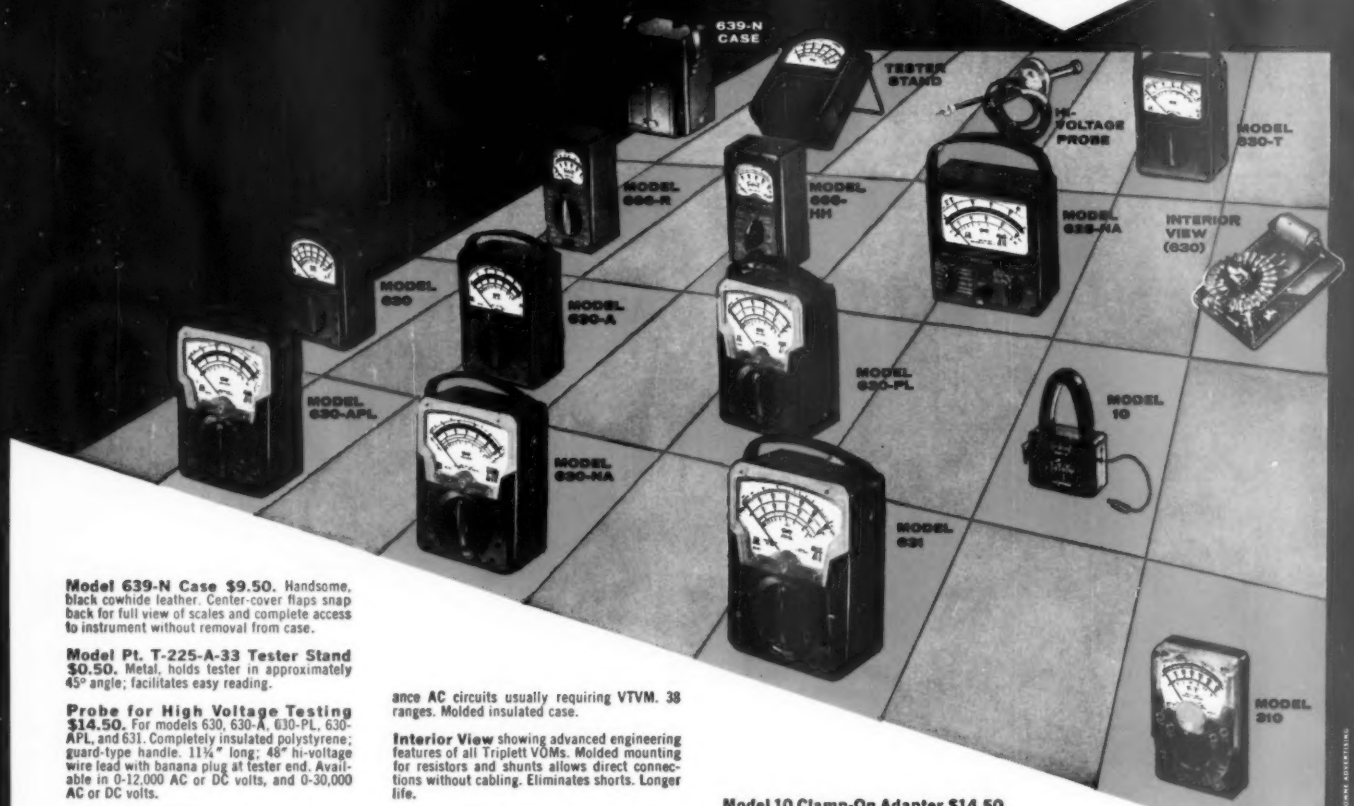
EDITOR
UNIVERSITY MICROFILMS
313 NO FIRST ST
ANN ARBOR MICH

. . . the smartest move you can make

is to TRIPLETT VOMs

. . . the world's most complete line of VOMs for every purpose!

TRIPLETT
Quality... First to last



Model 639-N Case $9.50. Handsome, black cowhide leather. Center-cover flaps snap back for full view of scales and complete access to instrument without removal from case.

Model Pt. T-225-A-33 Tester Stand $0.50. Metal, holds tester in approximately 45° angle; facilitates easy reading.

Probe for High Voltage Testing $14.50. For models 630, 630-A, 630-PL, 630-APL, and 631. Completely insulated polystyrene; guard-type handle. 11¾" long; 48" hi-voltage wire lead with banana plug at tester end. Available in 0-12,000 AC or DC volts, and 0-30,000 AC or DC volts.

Model 630-T $54.50. Specially designed for telephone maintenance. 2% accuracy on DC. Fused protected circuit protects resistors and meter in ohms ranges. Special neck strap holds instrument, freeing both hands. Banana jack connectors eliminate all shock hazard. Completely insulated case protects from ground.

Model 666-R Pocket VOM $29.50. Hand size, ideal for electrical maintenance. With recessed range knob it fits easily into case. AC rectifier pre-calibrated unit for easy replacement. Banana jacks at panel top prevent leads falling over meter dial. Single king-size selector switch minimizes incorrect settings, burnouts. 20 ranges. Molded case streamlined, fully insulated.

Model 666-HH Pocket VOM $27.50. Compact, hand-size; 3" meter integral with panel, adjusted to 400 microamperes at 250 millivolts. Only 3 jacks necessary for all ranges. 19 ranges.

Model 625-NA $54.50. Dual sensitivity for extra ranges; large mirror scale for super readability. 3-color meter scale 5" long. 6" instrument, 0-50 microamp. AC volts at 10,000 Ω/V for checking many audio and high impedance AC circuits usually requiring VTVM. 38 ranges. Molded insulated case.

Interior View showing advanced engineering features of all Triplett VOMs. Molded mounting for resistors and shunts allows direct connections without cabling. Eliminates shorts. Longer life.

Model 630 $44.50. Popular, streamlined; long meter scales for easy reading. Outstanding linear ohm scale; low reading .1 ohm, high 100 megs. Single king-size selector-switch minimizes incorrect settings, burnouts. High sensitivity: 20,000 ohms per volt DC; 5,000 AC. Molded, fully insulated case.

Model 630-A $54.50. Laboratory type; ½% resistors for greater accuracy. Long mirrored scale eliminates parallax. Banana jacks, low resistance connections; high flux magnet increases ruggedness. Single king-size selector switch minimizes incorrect settings, burnouts. Molded fully insulated case.

Model 630-PL $44.50. Instant-vision, wider spread scales; streamlined case; handsome modern design. Unbreakable window. Outstanding linear ohm scale; low reading .1 ohm; high to 100 megs. Single king-size selector switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5,000 ohms per volt AC; 20,000 ohms per volt DC.

Model 10 Clamp-On Adapter $14.50. Checks line loads with model 310 (can also be used with 6 other models). Instant, accurate, safe. No circuit breaking or work interruption. Easy range switching. Available in 6 AC Ammeter ranges: 0-6-12-30-60-120-300. Clips around single wire to read AC. Amperes direct. Use with adapter 101 to instantly divide 2-conductor cords. Molded case fully insulated, black plastic with engraved white markings.

Model 630-APL $54.50. Laboratory type with ½% resistors, more accurate movement. Long mirrored scales eliminate parallax. Unbreakable window. Single king-size switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5000 ohms per volt AC; 20,000 ohms per volt DC. Molded case fully insulated.

Model 630-NA $74.50. Super DeLuxe with 70 ranges—nearly double conventional types. Frequency compensated from 35 cps to 20 kc. Temperature compensated. Accurate within 1½% full scale reading on DC. Large open front meter easy to read. Unbreakable window. Mirrored scale. Meter protection against overloads. Molded fully insulated case.

Model 631 Combination VOM and VTVM $64.50. Two fundamental units at the price of a single tester. The No. 1 instrument for all electronic men. Battery operation assures VTVM stability and long life. Sensitivity PLUS. 1.2 volt (VTVM) range is equal to more than nine million ohms per volt. Large easy to read meter with unbreakable face. Single king-size selector switch minimizes incorrect settings, burnouts. Molded case fully insulated.

Model 310 $34.50. The only complete miniature VOM with 20,000 ohms per volt and selector range switch. Self-shielded against strong magnetic field. Rugged, high torque, bar-ring instrument. Unbreakable plastic meter window. Converts to common probe—frees one hand—by fitting interchangeable test prod into top. Standard sensitivity 20,000 ohms per volt DC, and 5,000 ohms per volt AC. Accuracy 3% DC. Molded fully insulated case.

TRIPLETT
Quality... First to last

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

If you have some knowledge of Radio or Television or Electronics now and want to BECOME A PROFESSIONAL SERVICE TECHNICIAN

Over 40 years ago, J. E. Smith, founder of the National Radio Institute, pioneered in teaching Radio by the home study method. Today, this magnificent building is completely devoted to NRI's Radio-TV Electronics training. Here up-to-date laboratory and research facilities are constantly testing new developments and improved methods of training men for Radio-TV Electronics careers.

All-Practice Method

NRI's Professional TV Servicing Training is practical, complete. You make tests and experiments to help thoroughly understand TV problems. You get equipment to build a 5" Oscilloscope, a 17" picture tube and all components for building a TV receiver. Comprehensive Color TV manuals also included. You learn how experts diagnose TV defects, get knowledge of professional techniques. Mail the coupon for free catalog now. NATIONAL RADIO INSTITUTE, Washington 16, D. C.

you will want to investigate the special ALL-PRACTICE TRAINING PLAN developed for men like you by the OLDEST AND LARGEST home study Radio-Television school

MAIL THIS TO NRI NOW

National Radio Institute, Dept. 9KFT, Washington 16, D.C.

Accredited Member National Home Study Council

Please send me a FREE copy of your catalog "How to Reach the Top in TV Servicing." I understand no salesman will call.

Name..... Age.....

Address.....

City..... Zone..... State.....

(Note: This training is NOT for beginners)

OVER 50 YEARS OF ELECTRONIC PUBLISHING

OCTOBER, 1959

Radio-Electronics

Formerly RADIO-CRAFT ■ Incorporating SHORT WAVE CRAFT ■ TELEVISION NEWS ■ RADIO & TELEVISION

EDITORIAL

33 **Future Audio Goals**—Hugo Gernsback

AUDIO-HIGH FIDELITY

34 **Transistor OTL Delivers 8 Watts (Cover feature)**—Daniel Meyer
39 **Tape Machines for Stereo**—Charles B. Graham
42 **Hi-Fi Servicing Needs New Methods**—Felix Bremy
44 **New Discs and Tapes, Stereo and Mono**—Reviewed by Chester Santon
46 **Integrate for Stereo**—Larry Steckler
50 **All About the Reflex Enclosure, Part VIII**—P. G. A. H. Voigt
53 **Adapt Your Tape Recorder to Record Stereo**—Peter A. Stark

RADIO

55 **Transistor Transceiver for Citizens Radio**—Floyd Ducote and Harry Cooke
58 **Rejuvenation for the AM Detector**—Leonard E. Geisler
59 **Transistor Converter Hauls in Ham Bands**—Robert F. Scott
61 **Radio, TV and the USSR**—Larry Steckler

WHAT'S NEW

62 **Pictorial Report of New Developments**

TEST INSTRUMENTS

64 **New Life for Your Tube Tester**—Leo L. Bowman
65 **Audio Millivoltmeter**—Martin De France
74 **Shortwave Calibrator**—I. Queen
76 **Technician's Transistor Checker**—Joseph E. Pontius

TELEVISION

84 **TV Service Clinic**—Conducted by Robert G. Middleton
88 **Diagnose Common TV Faults**—A. V. J. Martin
90 **The Customer Is Right!**—Jack Darr

ELECTRONICS

99 **Danger!**—Edmund H. Marriner
102 **Electronics Does the Counting**—Elliott A. McCready
106 **Sensitive Signal Circuit**—Nathaniel Rhita
112 **Technicians Look at Electronic Weighing Systems, Part II**—Edwin Bohr
114 **Simple Transistor Timer**—Joseph Braunbeck
118 **Hints from a Transithuiast's Workshop**—Martin Klein

154 **Books**
140 **Business and People**
149 **Correction**
24 **Correspondence**
150 **Literature**
145 **New Tubes and Semiconductors**
6 **News Briefs**
126 **Noteworthy Circuits**
130 **On the Market**
120 **Patents**
136 **Technicians' News**
123 **Technotes**
143 **Try This One**
125 **50 Years Ago**

ON THE COVER

(Story on page 34)

This all-transistor 8-watt amplifier is designed as a companion unit for stereo.

Color original by Habershaw Studios, New York, N. Y.

Hugo Gernsback .....Editor and Publisher
M. Harvey Gernsback .....Editorial Director
Fred Shunaman .....Managing Editor
Robert F. Scott .....W2PWG, Technical Editor
Larry Steckler .....Associate Editor
I. Queen .....Editorial Associate
Robert G. Middleton .....Television Consultant
Elizabeth Stalcup .....Production Manager
Wm. Lyon McLaughlin ....Tech. Illustration Director
Sol Ehrlich .....Art Director
Fred Neinast .....Staff Artist
Lee Robinson ....Director, Advertising Sales
John J. Lamson .....Eastern Sales Manager
G. Aliquo .....Circulation Manager
Adam J. Smith ....Director, Newsstand Sales
Robert Fallath .....Promotion Manager

ABC AUDITED PAID CIRCULATION

Average Paid Circulation Over 187,000

INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC.

RADIO-ELECTRONICS is indexed in *Applied Science & Technology Index* (Formerly *Industrial Arts Index*)

RADIO-ELECTRONICS, October, 1959, Vol. XXX, No. 10. Published monthly at Mt. Morris, Ill., by Gernsback Publications, Inc. Second-class postage paid at Mt. Morris, Ill. Copyright 1959 by Gernsback Publications, Inc. All rights reserved under Universal, International and Pan-American Copyright Conventions.
SUBSCRIPTION RATES: U.S., U.S. possessions and Canada, $4.00 for one year; $7.00 for two years; $10.00 for three years. Pan-American countries $5.00 for one year; $9.00 for two years; $13.00 for three years. All other countries $5.50 a year; $10.00 for two years; $14.50 for three years.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., 154 West 14th St., New York 11, N.Y. When requesting a change of address, please furnish an address label from a recent issue. Allow one month for change of address.
GERNSBACK PUBLICATIONS, INC. Executive, Editorial and Advertising Offices, 154 West 14th St., New York 11, N.Y. Telephone Algonquin 5-7755. **Hugo Gernsback**, Chairman of the Board; **M. Harvey Gernsback**, President; **G. Aliquo**, Secretary.
BRANCH ADVERTISING OFFICES and **FOREIGN AGENTS** listed on page 157
POSTMASTER: If undeliverable, send Form 3579 to: RADIO-ELECTRONICS, 154 West 14th St., New York 11, N.Y.

*Trademark registered U. S. Pat. Office.

NOW! at a price you can afford!

MAKE MORE MONEY in TELEVISION
RADIO-ELECTRONICS

BETTER...MORE COMPLETE...LOWER COST... WITH NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING!

BETTER... Training that is proved and tested in Resident School shops and laboratories, by a School that is the OLDEST and LARGEST of its kind in the world.

MORE COMPLETE... You learn ALL PHASES of *Television-Radio-Electronics.*

LOWER COST... Other schools make several courses out of the material in our ONE MASTER COURSE . . . and you pay more for less training than you get *in our course* at ONE LOW TUITION!

These two FREE books will show you how!

You get all information by mail . . . You make your own decision . . . at home! NO SALESMAN WILL CALL

TOP PAY...UNLIMITED OPPORTUNITIES LIFETIME SECURITY CAN BE YOURS!

You are needed in the Television, Radio, and Electronics industry! Trained technicians are in growing demand at excellent pay— in ALL PHASES, including Servicing, Manufacturing, Broadcasting and Communications, Automation, Radar, Government Missile Projects.

NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

YOU LEARN BY BUILDING EQUIPMENT WITH KITS AND PARTS WE SEND YOU. Your National Schools course includes thorough *Practical* training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step, perform more than 100 experiments, and you build a complete TV set from the ground up, that is yours to keep! A big, new TV picture tube is included at no extra charge.

EARN AS YOU LEARN. We'll show you how to earn extra money right from the start. Many of our students pay for their course—and more—while studying. So can you!

LESSONS AND INSTRUCTION MATERIAL ARE UP-TO-DATE, PRACTICAL, INTERESTING. Every National Schools Shop-Method lesson is made easy to understand by numerous illustrations and diagrams. All instruction material has been developed and tested in our own Resident School Shops, Laboratories and Studios.

SEND FOR INFORMATION TODAY . . . it can mean the difference between SUCCESS and failure for you! Send for your FREE BOOK "Your Future in Television-Radio-Electronics" and FREE Sample Lesson. Do it TODAY, while you are thinking about your future. It doesn't cost you anything to investigate!

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shops, Labs and Radio-TV Studios. Here you work with latest Electronic equipment - - professionally installed - - - finest, most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school - - and part time job while you learn. Check box in coupon for full information.

GET THE BENEFITS OF OUR OVER 50 YEARS EXPERIENCE

Approved for GI Training

MEMBER

NATIONAL SCHOOLS
Los Angeles 37, Calif.

YOU GET...

- 19 Big Kits—YOURS TO KEEP!
- Friendly Instruction and Guidance
- Job Placement Service
- Unlimited Consultation
- Diploma—Recognized by Industry
- EVERYTHING YOU NEED FOR SUCCESS!

SHOP-METHOD HOME TRAINING COVERS ALL PHASES OF INDUSTRY

1. Television, including Color TV
2. Radio AM & FM
3. Electronics for Guided Missiles
4. Sound Recording and Hi-Fidelity
5. FCC License
6. Automation and Computers
7. Radar & Micro-Waves
8. Broadcasting and Communications

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

MAIL NOW TO
NATIONAL SCHOOLS, Dept RG-109
4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ AGE _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

☐ Check if interested ONLY in Resident School training at Los Angeles.

VETERANS: Give date of Discharge _____

NEWS BRIEFS

SOUND CONTROL OF ROCKETS may be in the offing if present investigations using high-intensity (176-db) high-frequency sound to control the burning rate of solid rocket fuel pay off. At present, it is impossible to control the burning of solid propellants so they burn at an uneven rate, slowly at first and more rapidly as burning continues.

The intense sound will aid in mixing the components of the solid fuel, with lower intensity producing a lower combustion rate. Thus by using the ultrasonic "blast" at full power first, then reducing the intensity, the burning rate can be evened out. Simpler rocket engines and higher power-to-weight ratios will result if this idea, advanced by Acoustica Associates of Plainview, N. Y., and now being underwritten by a Government contract, proves correct.

MISSILE FIRINGS and bomb blasts anywhere can be detected with a new high-frequency back-scatter scheme revealed by the Office of Naval Research. The ONR has run tests to prove its theory for over 20 months, monitoring nuclear blasts, missile firings and satellite launchings. Making use of ionospheric reflection, the results are similar to radar, but work over thousands of miles.

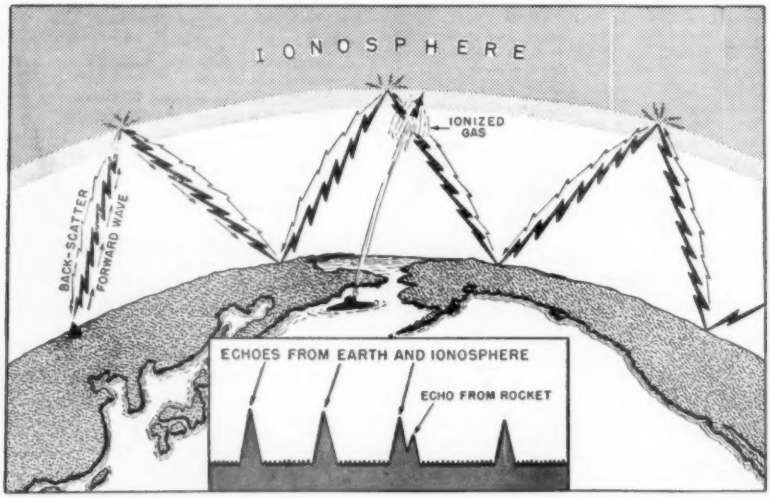
Project Teepee is a radio monitoring system using transmitters of 15 to 50 kw, as opposed to the BMEWS (Ballistic Missile Early Warning System) radars which emit millions of watts. Teepee bounces electromagnetic waves off the ionized blast cloud of a nuclear bomb or a climbing rocket's ionized exhaust. These large clouds of ions reflect high-frequency waves in much the same way that solid objects reflect radar pulses.

Ordinarily, ionospheric back-scatter would appear on a scope as a regular succession of blips. When the receiver gets back a little energy from a cloud of ionized gas, there is an extra little blip displayed. Prior calculations of the radio propagation path can use the shape and location of the blip to locate the disturbance responsible for it.

Whereas BMEWS affords 15 minutes' warning when a hostile missile is launched overseas, Teepee should provide 30 minutes' notice when a intercontinental ballistic missile is fired.

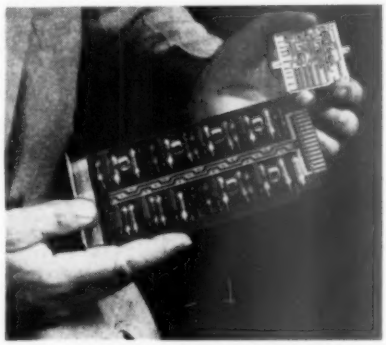
Teepee will ultimately lessen the need for some radar and other warning systems such as DEW line, BMEWS and Project Midas, the infra-red detecting system which would use satellites with infra-red sensors.

Although Teepee has monitored hundreds of missile and satellite firings and bomb tests as far back as the launching of Sputnik I near the end of 1957, it is still in the experimental stage. The head of the project, Dr. W. J. Thaler, who was senior scientist of Project Argus (RADIO-ELECTRONICS, page 49, May, "A-Bomb Proves Earth's Magnetic Field") said, "We are confident a reliable system capable of reliable detection over intercontinental ranges is feasible and can be developed within a few years. . . . The same basic system could also be used to monitor a nuclear test ban because it has already detected atom-bomb explosions at thousands of miles."



Top: How radio signals are reflected back and forth between earth and ionosphere. Thin arrows show direction of back scatter. Bottom: How the back-scatter reflections appear on a scope. Ionized gas from a rocket firing produces blip where it would not normally be expected.

MICROMINIATURE RESISTORS as well as capacitors and interconnections can now be sputtered onto very thin ceramic cards in one operation. Resistors as thin as 1 mil can be made in the process, developed by D. A. McLean of Bell Telephone Laboratories. Shown in the



photograph here is a 2 x 2-inch card containing a three-stage multivibrator which previously required 7 x 3½ inch in standard printed circuitry. The sputtered technique placed 24 resistors on the card, plus 9 capacitors and plug-ins for 6 transistors and 9 diodes. Reliability of these units will be very high due to formation of resistors, capacitors and interconnections all of from one metal, tantalum in this case, and all at the same time.

HIGHWAY HI-FI is expected to come in strong with the 1960 Plymouth and DeSoto cars. RCA is supplying special 45-rpm players to the Chyrsler Corp. RCA officials said they have units available but couldn't show them ahead of Chrysler's car previews.

WOMAN-SPOTTING RADAR developed for the Army works on pulse Doppler techniques and is so sensitive that an experienced operator can hear and see whether a moving object thousands of yards away is a man, a group of soldiers, a jeep or a woman. The radar

Men 17-55

READ THESE AMAZING FACTS ABOUT A MAN WHO COULD BE YOU!

Are YOU One of the men who could prepare for a job that PAYS REAL MONEY in

TELEVISION RADIO Electronics

EMPLOYMENT SERVICE

NOTHING ELSE LIKE IT

NO PREVIOUS TECHNICAL EXPERIENCE NEEDED

NO ADVANCED EDUCATION NEEDED

LEARN AT HOME OR . . .

. . IN OUR CHICAGO OR TORONTO LABORATORIES

ONLY DeVRY OFFERS ALL THESE FEATURES!

Only DeVry Tech provides Training Movies to make the basic principles of Electronics crystal clear! DeVry's explanations and illustrations are a pleasure to follow. Over 300 practical experiments with actual Electronic parts are included to give you on-the-job type know-how. You even build your own test equipment.

EMPLOYMENT SERVICE

The Industry knows the quality of DeVry training. That's why our Employment Service usually has more demands for graduates than we can fill. We can also help you get started in your own shop.

ARE YOU PASSING UP THE PAYCHECK—THE SOLID FUTURE —THE REAL BREAK—YOU'VE ALWAYS DREAMED OF?

You meet them almost every day . . . the men who want to advance out of humdrum, low-pay, or no-future jobs. Some are men who had to quit school too soon; men just out of school with no idea of what to do; or men looking for help in planning a better future. Yet, many of them could—can, if they're 17-55—train at home, in their spare time, for an exciting career with real money and an inspiring future in the field of Electronics. And the tragedy of it is: they don't know it! They think they need an advanced education, or some special experience, or a lot of money, to start—but what they need most is the will to win. Maybe you're a man like that. Well, here's great news! It's not too late! Electronics offers men like you, when trained, dozens of different job opportunities—from guided missile control to running your own radio-television service shop. Get the full story of the jobs you may prepare for . . . NOW . . . BEFORE the years and responsibilities close in on you. Send coupon today—no obligation.

2 MODERN TRAINING CENTERS

Large modern training centers in Chicago and Toronto offer DeVry students day and evening classes. The staffs, facilities and experience of these centers stand back of the home training programs. Whether you train at home or in residence, you're a DeVry Tech man. Look into it now!

Be A Standout in Electronics . . .

Be A DeVry Tech Man!

DON'T DELAY!

Accredited Member of National Home Study Council

"One of North America's Foremost Electronic Training Centers"

DeVRY TECHNICAL INSTITUTE

4141 Belmont Avenue • Chicago 41, Illinois

Formerly DeForest's Training, Inc.

MAIL COUPON TODAY

DeVRY TECHNICAL INSTITUTE

4141 Belmont Ave., Chicago 41, Ill., Dept. RE-10-P

Please give me your FREE booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel," and tell me how to prepare to enter one or more branches of Electronics.

NAME _____ AGE _____

PLEASE PRINT

STREET _____ APT. _____

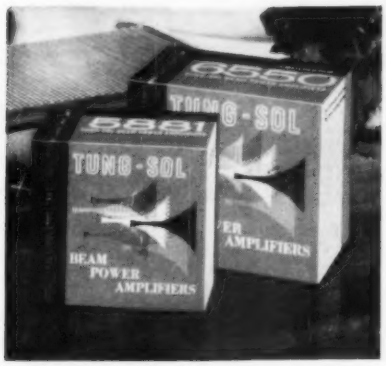
CITY _____ ZONE ____ STATE _____

☐ Check here if subject to military training.

DeVry Tech's Canadian Training Center is located at 626 Roselawn Avenue, Toronto 12, Ontario.

2060

Tung-Sol audio tubes dynamically balanced and twin-packed in matched pairs by the manufacturer



5881 For service in amplifiers of up to 50 watts.

6550 For service in amplifiers and commercial audio equipment of up to 100 watts.

Now you can come as close to faultless sound reproduction as the design and circuitry of your hi-fi equipment will permit. Tung-Sol 5881 and 6550 beam-power amplifier tubes are dynamically balanced and factory-matched to very tight performance limits to help you achieve lowest distortion at all volume levels.

Use of Tung-Sol 5881 and 6550 tubes has long been associated with amplifiers of the very finest design. These tubes have always been produced to closest possible tolerances with cathode current ranges held to an absolute minimum.

Now, in twin-packed pairs, they assure the hi-fi enthusiast and the commercial sound engineer of replacement tubes that will provide new standards of performance — a feature of special importance with the newest amplifiers and loudspeakers, particularly binaural sound equipment. See your parts supplier.

Tung-Sol Electric Inc., Newark 4, New Jersey.

TUNG-SOL®

transmits pulses into a 30° sector, then receives reflected pulse energy from stationary terrain as well as from moving targets.

The portion of the reflected-signal energy coming back from the moving object is shifted in frequency continuously (Doppler shift). That signal is converted in the set to an audio tone equivalent to 30 cycles a second for each mile-per-hour motion. If an object is moving at a steady 3 miles an hour, the operator hears a 180-cycle sound. A man swinging his arms would produce other, more complex sounds fluctuating, say, between 120 and 240 cycles, if close enough (perhaps a mile) to reflect enough energy for that detail.

A vehicle produces a higher tone because it moves faster, and a woman's shorter, peppier walk has an identifiable sound. The four photo tracks shown here are made by a train, an auto, a man and a woman walking. The radar has spotted a single man at 15 miles under ideal conditions. It's a highly mobile set which includes a 5-foot plastic radome set on a 25-foot pole. It was developed by the Army and Hazeltine Corp.

CLOSED-CIRCUIT TV was used in a novel combination of applications when the nuclear-powered merchant ship Savannah was christened by Mrs. Dwight Eisenhower. CCTV cameras picked up the working of the reactor below decks. It was displayed for the guests on a 6 by 8-foot TV screen upstairs, which also serves for movies and standard TV programs. This programming can be viewed in other lounges in addition to the main lounge, crew quarters and 37 staterooms, over the RCA-equipped system.

FM IS GROWING AGAIN, according to latest FCC figures. There were 79 FM transmitters authorized during early 1959, 7 more than on AM. FM grew rapidly during the years just after WW II, then shrank after 1949. The low point was reached in 1955 when there were only 557 valid station grants. Today there are 620 FM stations on the air, with over 765 active authorizations. As FM receivers continue spreading into every household, FM stations will keep increasing in importance and number. Several manufacturers are readying auto sets with FM, too.

Hundreds of thousands of people living in New York and New England know that FM is really growing because they listen to fine music FM network QXR. This largest FM net has just added WTAG-FM in Worcester, Mass. with 10 kw. WTAG-FM is the 14th QXR affiliate; other stations range from 5 to 40 kw.

(A man called RADIO-ELECTRONICS the other day for information. Said he knew that FM meant frequency modulation, "But what does AM mean?"—*Editor*)

ONE NEW TV STATION has begun programming since we last reported:
WAFG, Huntsville, Ala.....31

The US total remains the same, however, as we lost:
KSPR-TV, Casper, Wyo. 6

WICC-TV, Bridgeport, Conn., channel 43, went dark for just one month from Aug. 12 to Sept. 13.

New call letters were made official by the following two stations:
WLUC-TV, Marquette, Mich.....6
(formerly WDMJ-TV)
WLUK-TV, Marinette-
Green Bay, Wis. 11
(formerly WMBV-TV)

The US operating station total remains 558, but there are now 468 vhf and 90 uhf stations. The noncommercial group still numbers 42.

MONKEY BEHAVIOR, and presumably the behavior of man, can be changed temporarily by applying painless electrical pulses to various areas of the brain through surgically implanted hair-thin electrodes.

Under stimulation from a collar-carried transistor unit, the monkeys were made to eat up to seven times their normal intake, to suddenly seek out a mate, to lose their ferocity and ability to "boss" others around, or conversely to become menacing and fierce.

The current used, according to Dr. Jose Delgado of the Yale Medical School, research surgeon who is conducting the experiments, is so weak that it could probably not be felt by the tongue, which is more sensitive to an electrical charge than any other part of the body.

PLANE TABOO ON RADIOS is now in effect on overseas flights to protect cockpit receivers from radiation sent out by oscillators of passenger portables. The International Air Transport Association, including all major overseas airways, agreed to ban passenger use of radios and recorders. It was first considered that the plane's equipment might be shielded but this was ruled out because transistor portables radiate out the windows direct to plane antennas.

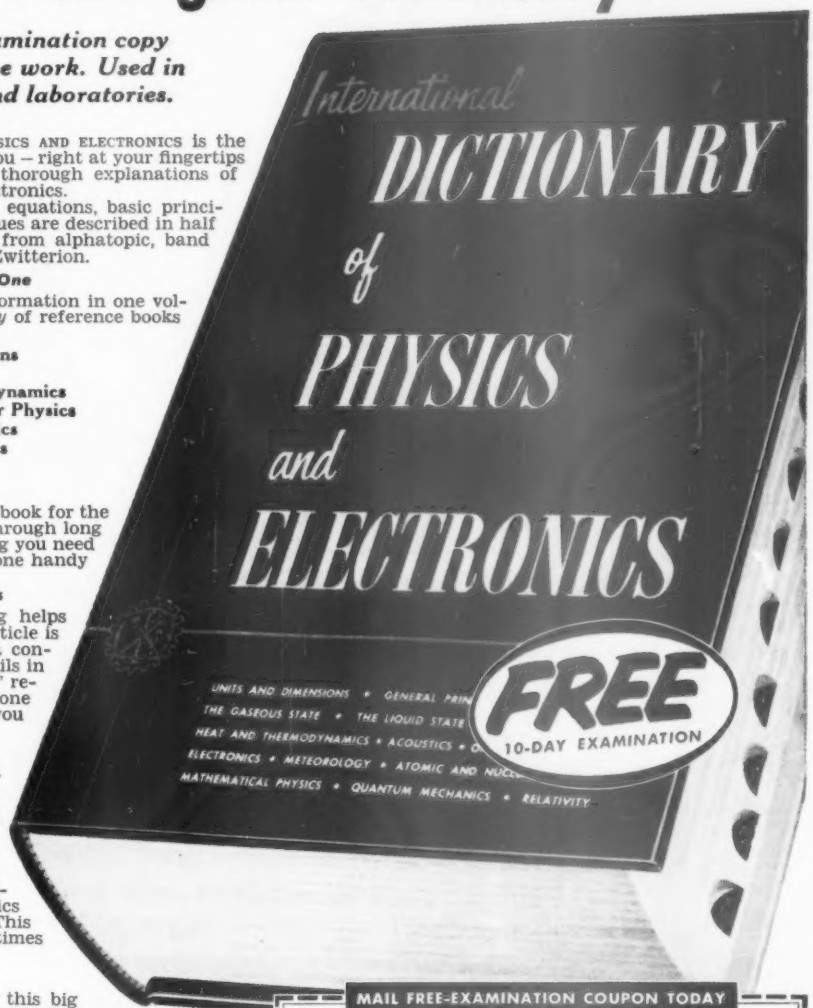
Tape recorders' bias oscillators are only 30 to 90 kc, but work at much higher power levels than most superhet oscillators. Thus those with bad bias waveforms can produce harmonics at communications or navigation frequencies.

STEREOCASTING situation may be cleared up before winter's end. The National Stereophonic Radio Committee (NRSC) is trying to reduce the many competing systems to three, then decide between them. The systems were placed

Every Essential Term in Physics and Electronics – 12,000 of Them

– now in one giant dictionary!

Send today for a free-examination copy of this 1000-page reference work. Used in homes, offices, schools and laboratories.



THE INTERNATIONAL DICTIONARY OF PHYSICS AND ELECTRONICS is the only book available today that gives you – right at your fingertips – definitions, equations, principles and thorough explanations of *every* important term in physics and electronics.

More than 12,000 laws, relationships, equations, basic principles, instruments, apparatus and techniques are described in half a million words. You'll find everything from alphatopic, band and cybotaxis to Wronksian, ylem and Zwitterion.

16 Reference Books in One

You've never seen *so much* useful information in one volume. It takes the place of *a whole library* of reference books on:

Electronics	**Units and Dimensions**
Meteorology	**General Principles**
Mechanics	**Heat and Thermodynamics**
Gases	**Atomic and Nuclear Physics**
Liquids	**Mathematical Physics**
Solids	**Quantum Mechanics**
Acoustics	**Electricity**
Optics	**Relativity**

No more hunting around from book to book for the information you need. No more wading through long texts to get a simple definition. Everything you need can be found simply and quickly in this one handy volume.

Answers Your Questions in Seconds

A unique system of cross-referencing helps you locate information instantly. Each article is arranged progressively, beginning with a concise definition and adding additional details in later paragraphs. Boldface "word signals" refer you to other articles relating to the one you are reading. You get the answers you want *in a hurry!*

Save Time – Avoid Costly Errors

You'll turn to this giant, 1000-page reference work dozens of times a day – to recheck your work, to clarify technical articles or engineering data, to increase your own understanding of the complex world of physics and electronics. Where you might otherwise trust your memory, you'll now turn to the International Dictionary of Physics and Electronics to get an answer *you can be sure of*. This helpful volume can pay for itself many times over in just one avoided error!

Examine it For 10 Days FREE

To fully appreciate the usefulness of this big 2¼" thick book, we invite you to use it for ten days. If you do not find it to be one of the most valuable books you have ever owned, you may simply return it and owe nothing. Otherwise, remit payment on the easy terms indicated in coupon. You take no risk. Send coupon today to ***D. Van Nostrand Company, Inc., Dept. 1810A, 120 Alexander St., Princeton, N. J.*** *(Established 1848).*

Acclaimed by Major Journals in Every Field of Science

"Unique. Useful. Presents a wide variety of terms" – **SCIENTIFIC AMERICAN**

"Remarkably complete. Highly useful. Provides definite and concise answers to a myriad of questions." – **PHYSICS TODAY**

"Will undoubtedly make a well-deserved place for itself." – **SCIENCE**

"There has been a real need for such a work." – **ELECTRONICS**

"Recommended for all that do any reference work in physics." – **LIBRARY JOURNAL**

"Unique in its field and exceptionally clear in its typography. It should prove a most useful reference." – **NUCLEONICS**

"The best book of definitions available on the market today. Highly recommended." – **TELE-TECH**

MAIL FREE-EXAMINATION COUPON TODAY

D. Van Nostrand Company, Inc., Dept. 1810A
120 Alexander Street, Princeton, N. J.

Please send me – for 10 days' FREE examination – the "International Dictionary of Physics and Electronics" thumb-indexed edition. If not completely satisfied, I may return it and owe nothing. Otherwise I will remit $7.50 plus small shipping cost, and $5 a month for 3 months.

Name.....

Address.....

City.....Zone....State.....

☐ Save! Enclose full payment ($22.50) and shipping costs will be prepaid. Money back if not delighted.

In Canada: Order from D. Van Nostrand Co., Ltd., 25 Hollinger Road, Toronto 16, Canada (Price slightly higher)

Hit any target

with

Centralab

Universal Shaft

Model B

Radiohm® Controls

If you're aiming for faster servicing and greater profits, ask for CENTRALAB Model B Controls. These are the only replacement carbon controls with a truly universal shaft that adapts to any application.

For any shaft target—split knurl, shallow flat, deep flat, half round, round, etc.—the Model B hits the bulls-eye. Its universal fluted, knurled-type shaft adapts to all knobs perfectly. AC Line switches snap right on, trigger-quick, to convert the control to a switch type unit.

Shoot right over to your CENTRALAB distributor and stock up on Model B Controls . . . and while you're there, be sure to Tell him you want your free copy of the brand-new CENTRALAB catalog.

Centralab B-5957

A DIVISION OF GLOBE-UNION INC.
922K E. KEEFE AVE. • MILWAUKEE 1, WIS.
IN CANADA: 669 Bayview Ave. • Toronto 17, Ont.

CONTROLS • ROTARY SWITCHES • CERAMIC CAPACITORS
PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

on basis of family resemblance in an FM–AM group (GE, Philco, Zenith), the FM–FM group (Calbest, Crosby, Halstead) and the English Percival system. The FCC has set a deadline of Dec. 11 for filing proposals on stereocasting, and the NRSC may well come up with its recommendation by then.

Calendar of Events—October

Industrial Electronics Symposium, Sept. 30–Oct. 1, Mellon Institute, Pittsburgh, Pa.

Stereo and Hi-Fi Show, Oct. 2–4, Davenport Hotel, Spokane, Wash.

National Communications Symposium, Oct. 5–7, Hotel Utica, Utica, N.Y.

Motion Picture & Television Engineers Convention, Oct. 5–9, Statler-Hilton Hotel, New York.

Audio Engineering Society Convention and Equipment Exhibit, Oct. 5–9, Hotel New Yorker, New York, N.Y.

Institute of High Fidelity Manufacturers Hi-Fi Show, Oct. 5–10, New York Trade Show Building. (RADIO ELECTRONICS will exhibit in Room 525.)

EIA Value Engineering Symposium Oct. 6–7, University of Pennsylvania, Philadelphia, Pa.

Conference on Radio Interference Reduction, Oct. 6–8, Museum of Science & Industry, Chicago, Ill.

Canadian IRE Convention, Oct. 7–9, Exhibition Park, Toronto, Canada.

National Electronics Conference, Oct. 12–14, Hotel Sherman, Chicago, Ill.

Home Entertainment Show, Oct. 15–18, Rice Hotel, Houston, Tex.

Detroit High Fidelity Show, Oct. 16–18, Statler Hotel.

Portland (Ore.) Stereo & Hi-Fi Show, Oct. 16–18, Multnomah Hotel.

URSI Fall meeting, Oct. 19–21, El Cortez Hotel, Balboa Park, San Diego, Calif.

East Coast Conference for Aeronautical and Navigational Electronics, Oct. 26–28, Lord Baltimore Hotel, Baltimore, Md.

Michigan Industrial Electronics Exposition, Oct. 28–29, Detroit Artillery Armory, Oak Park, Mich.

Electron Devices Meeting, Oct. 29–30, Shoreham Hotel, Washington, D.C.

Buffalo (N.Y.) Hi-Fi Show, Oct. 30–Nov. 1, Statler Hotel.

SATELLITE USING SOLAR energy to power no less than three transmitters, two receivers and a simple TV scanning device is now in orbit. The new satellite is the paddle-wheeled, 142-lb Explorer VI. The "paddles" are actually four 20 x 20-inch vanes, with 1,000 solar cells on each of their surfaces.

Travelling 22,000 miles an hour, the satellite moves in an eccentric 12½-hour orbit that takes it to 25,000 miles away from the earth at its farthest point, at its nearest within 150 miles.

Two low-powered transmitters work on 108.06 and 108.09 mc for routine transmission of scientific information, and a higher powered (40-watt) transmitter operates intermittently—about 1½ hours out of every 6. The transmitter can be turned on and off by commands from the ground.

Fifteen major experiments are being conducted with electronic gear crammed into the 26 x 29-inch spheroid. Magnetometers will map the size, shape and

(*Continued on page* 18)

How to Get a Commercial FCC License

do you know what an FCC license really can do for you in Electronics?

1 More income for you every week

2 A more interesting job in electronics

The average person spends over 50% of his waking hours on the job (or going to and from the job). Therefore doesn't it make sense to have a job that is really interesting and also pays well?

The chances are very good that if you are reading this magazine you can qualify for the really good jobs in electronics like those shown in the pictures at the left . . . and it won't take long to do it. Your past training and experience in basic electronics (such as radio and TV repair, armed forces electronics, ham operators, etc.) can be the foundation for a profitable career as an "across-the-board" electronics technician.

Whether you run your own shop or work for someone else, the real money, the interesting work, is available to the man who can effectively handle the more complex electronic gear. Home receiver repair can provide a good living, but it can't match the opportunities open to a skilled electronics technician.

The Career Information Material shown below will show you how you can qualify for a government certificate of competency . . . a commercial FCC License . . . and acquire a really fine technical education. Find out how your success with the FCC examination is guaranteed . . . or your money back.

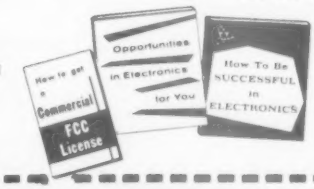
You will also find out which jobs require the FCC License . . . where technicians are needed . . . what a technician needs to know about electronics . . . and many other facts about opportunities for you in electronics.

It will cost you only the price of a postage stamp to get all the facts. If you are in any type of electronics work . . . or if you have had previous training or experience in electronics . . . you owe it to yourself to ask us to send you information on profitable careers in electronics.

CLEVELAND INSTITUTE OF ELECTRONICS

Desk RE-34B, 4900 Euclid Ave. **Cleveland 3, Ohio**

1. Raytheon Manufacturing Company
2. Radio Corporation of America
3. Jupiter IRBM, Army Ordnance Missile Command
4. Collins Radio Company
5. Radio Corporation of America



CLEVELAND INSTITUTE OF ELECTRONICS

Desk RE-34B, 4900 Euclid Ave., Cleveland 3, Ohio

Please send FREE Career Information Material prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

Name _____ Age _____

Address _____

City _____ Zone ____ State _____

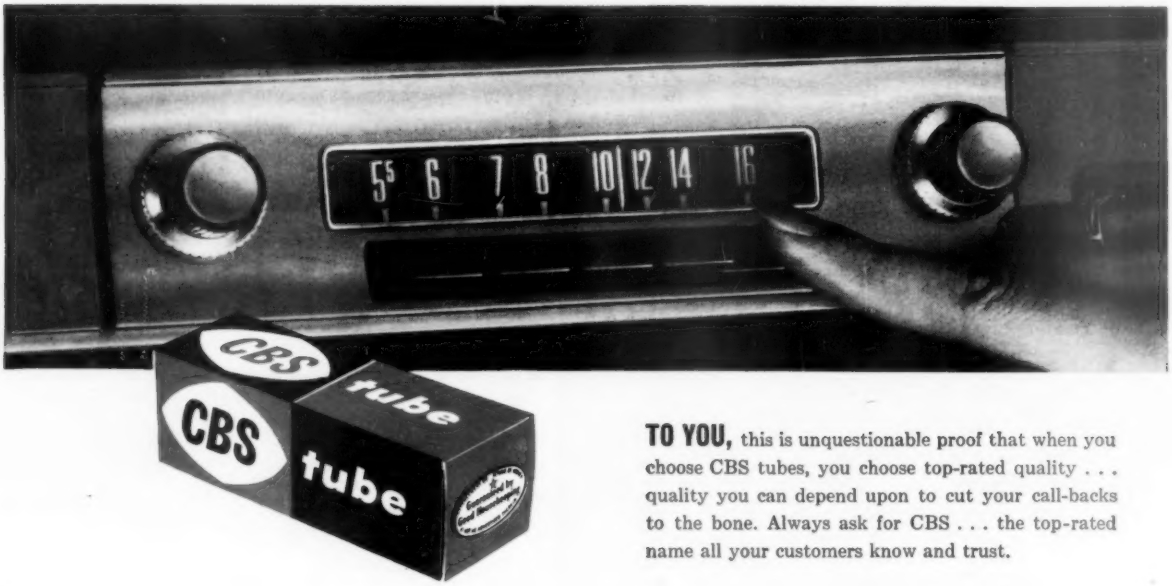
RE-34B,

CBS RADIO SHOWS TOP-RATED BY RATING SERVICES

During the first six months of 1959, an average of 20 of the 25 top-rated popular programs were on CBS Radio . . . over three times as many as on the other three networks combined. A consistent leader is the ARTHUR GODFREY SHOW, a radio favorite for years.

CBS TUBES TOP-RATED BY LEADING SET MANUFACTURERS

Leading set manufacturers constantly rate and re-rate receiving tubes for quality . . . brand by brand, type by type. We are proud to report that month after month CBS tubes consistently earn top ratings from these manufacturers, and maintain this approval.



TO YOU, this is unquestionable proof that when you choose CBS tubes, you choose top-rated quality . . . quality you can depend upon to cut your call-backs to the bone. Always ask for CBS . . . the top-rated name all your customers know and trust.

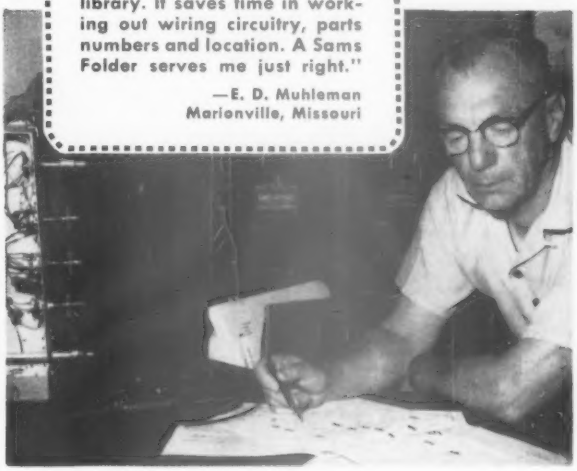
Receiving, industrial and picture tubes • transistors and diodes • audio components • and phonographs

CBS ELECTRONICS
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

Service Technicians: YOU EARN MORE... you RATE with the public when you own a PHOTOFACT® service data library!

"I think PHOTOFACTS are the best servicing help ever published."
—Edwin D. Mooers
Portland, Maine

"I couldn't afford to be without the PHOTOFACT reference library. It saves time in working out wiring circuitry, parts numbers and location. A Sams Folder serves me just right."
—E. D. Muhleman
Marionville, Missouri



Yes, if you are one of the thousands of owners of a complete PHOTOFACT Service Data Library, you are enjoying maximum earnings. It's inevitable, because no matter how expert you are, you can always *save more time* on *any* job, get *more* jobs done daily—EARN MORE, DAY IN AND DAY OUT...

Moreover—as the owner of a complete PHOTOFACT Library, *you* know your customers' sets *best*. You can actually show each customer you have the PHOTOFACT Folder covering his very own set. Result: You command public respect and acceptance which paves the way to expanded business for you...

HERE'S HOW TO STAY AHEAD...

Today, the truly successful Service Technicians are those who own the complete PHOTOFACT Library, who can meet and solve any repair problem—faster and more profitably. And these men *keep ahead* because they're on a Standing Order Subscription with their Distributors to receive all new PHOTOFACTS as they are released monthly.

For **PHOTOFACT** Library Easy-Buy Plan details and Standing Order Subscription, see your Sams Distributor today, or write to Howard W. Sams...

Howard W. Sams®

IT'S EASY TO OWN A PHOTOFACT LIBRARY

Howard W. Sams' Easy-Buy Plan is the money-saving way to build your complete profit-making **PHOTOFACT** Library. NO INTEREST—NO CARRYING CHARGE—AS LITTLE AS $10 DOWN...

FREE! Valuable steel file cabinets given to **PHOTOFACT** monthly subscribers and Library purchasers

FREE! Valuable booklet shows how **PHOTOFACT** boosts your profit capacity —send for it!

HOWARD W. SAMS & CO., INC.
2205 E. 46th St., Indianapolis 6, Ind.

☐ Send me Free booklet "Your Guide To Maximum Profits"

☐ I'm a Service Technician: ☐ full-time; ☐ part-time

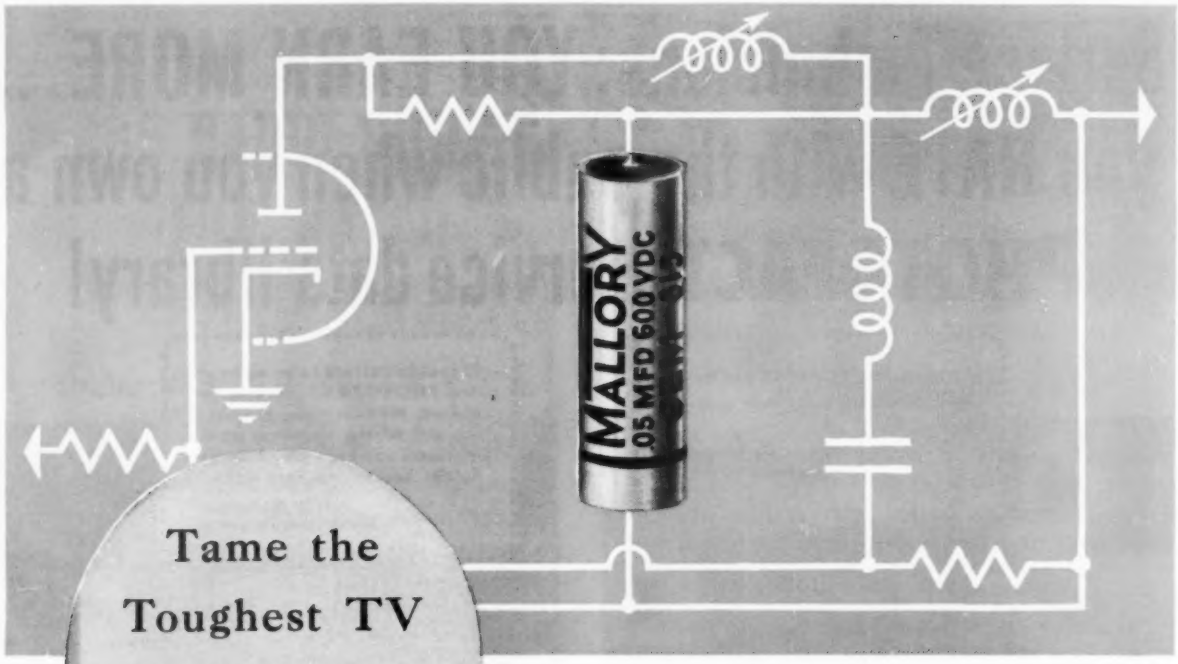
My Distributor is: _____

Shop Name _____

Attn: _____

Address _____

City _____ Zone _____ State _____

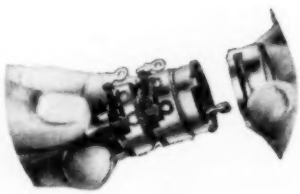


Tame the Toughest TV Replacement Spot with a.... Mallory Gem Capacitor

This circuit should be familiar—half of a 6SN7 serving as the horizontal oscillator in a typical TV receiver circuit. The marked spot in the diagram is a tough assignment for a capacitor. If it opens, you lose raster. If it changes capacity, or if the replacement is beyond tolerances, the horizontal sweep will not sync in.

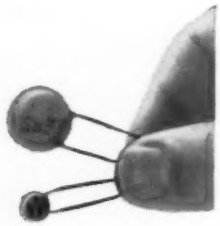
When replacing this capacitor, always use a Mallory Gem. It's moisture-proof—won't drift in capacity or internal resistance. Conservative voltage ratings guarantee reliability—in this, or any circuit. Get Gems today from your Mallory Distributor in the handy 5-pack.

FP Capacitors—the original 85°C filter



Sta-Lac Dual Controls—tailor-made in 30 seconds

Gold Label Vibrators—unequalled performance and life



RMC Discaps—world's leading ceramic capacitors

Depend on Mallory components for service

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

Learn Electronics

PREPARE FOR YOUR F. C. C. LICENSE—YOUR TICKET TO A BETTER JOB AND HIGHER PAY!

F.C.C. LICENSE—THE KEY TO BETTER JOBS

An F.C.C. *commercial* (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire *licensed* technicians.

WHICH LICENSE FOR WHICH JOB?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain and operate every type of radiotelephone equipment (except amateur) including all radio and television stations in the United States, its territories and possessions. This is the highest class of radiotelephone license available.

GRANTHAM TRAINING PREPARES YOU

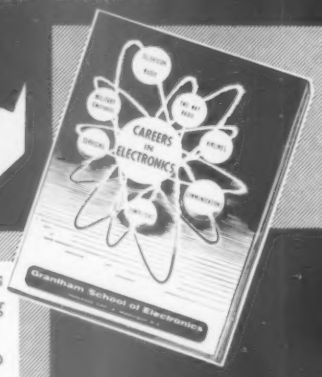
The Grantham Communications Electronics Course prepares you for a *FIRST CLASS* F.C.C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F.C.C. license.

CORRESPONDENCE OR RESIDENCE CLASSES

Grantham training is available by correspondence or in resident classes. Either way (residence or correspondence), we train you quickly and well—no previous training required. Even a beginner may qualify for his first class license in a relatively short time.

FOUR COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains four complete Divisions—located in Hollywood, Calif., Seattle, Wash., Kansas City, Mo., and Washington, D.C. All Divisions of Grantham School of Electronics offer the same rapid courses in F.C.C. license preparation, either by home study or in resident classes.*

This booklet **FREE!**



This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

Upgrade Your Income with a First Class

F. C. C. LICENSE

HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Donald E. Mason, 2659 Centinella, Santa Monica, Calif.	1st	12
Everett T. Bozard, 411 N. Wash. St., Alexandria, Va.	1st	12
Henry M. Best, 1003 Vermont St., Fremont, N. C.	1st	11
Harold V. Jones, P.O. Box 705, Alamogordo, N. M.	1st	13
Michael F. Aperio, 916 Townsend St., Chester, Pa.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Donald L. Leeburg, Box 1075, Anchorage, Alaska	1st	12
J. Milton Condit, 1312 N. 78th Street, Seattle, Wash.	1st	8
John H. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Richard Baden, 4226 - 37th St., N.W., Washington, D.C.	1st	12
James F. Stewart, 2618½ Prospect Ave., La Crescenta, Calif.	1st	12
Norman R. Cook, 130 Olive Street, Neodeska, Kans.	1st	12

GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD CALIF.	1505 N. Western Ave. Hollywood, Calif.	(HO 7-7727)
SEATTLE WASH.	408 Marion Street Seattle, Wash.	(MA 2-7227)
KANSAS CITY MO.	3123 Gillham Road Kansas City, Mo.	(JE 1-6320)
WASHINGTON D. C.	821 - 19th Street, N. W. Washington, D. C.	(ST 3-3614)

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: **GRANTHAM SCHOOL OF ELECTRONICS**

1505 N. Western Hollywood • 408 Marion Seattle • 3123 Gillham Rd. Kansas City • 821-19th, NW Washington

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes 94-R

knight-kits® A PRODUCT OF ALLIED RADIO make the Big News...

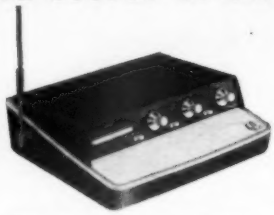
FREE send for it

see them in ALLIED'S 1960 catalog

THE WORLD'S LEADING ELECTRONIC SUPPLY GUIDE

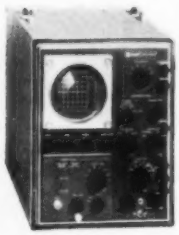
See these and scores of other great *knight-kits*

Y-731 Deluxe FM-AM Stereo Hi-Fi Tuner (Multiplex add-in).... **$87.50**
only $5 down

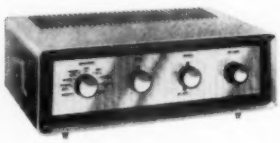


Y-712 Custom Superhet Citizen's Band Transceiver..... **$79.95**
only $5 down

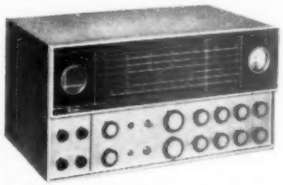
Y-608 Lab AC VTVM with Automatic Range Selection..... **$99.50**
only $5 down



Y-611 Lab DC Scope with Triggered Sweep and Plug-in Vertical Preamps (less Preamps) **$285.00**
only $10 down

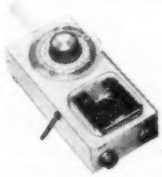


Y-773 Super-Value 20-Watt Stereo Hi-Fi Amplifier..**$44.50**
only $2 down



T-400 400-Watt Transmitter (AM and SSB add-ins available)..... **$395.00**
only $10 down

Y-708 1000 Ohm/Volt Pocket Volt-Ohm-Milliammeter..... **$9.95**



G-30 Amateur Grid Dip Meter (1.5-300 mc)... **$22.95**
only $2 down

Y-711 Ammeter-Voltmeter for Cars and Boats. **$10.75**

NEW LOWEST TERMS

Only $5 down (or less) on orders up to $200; up to 24 months to pay. Fast handling—no red tape.

there's a money-saving *knight-kit* for every need

SEE PAGE AFTER PAGE OF FASCINATING KITS, INCLUDING:

HI-FI KITS
Stereo Deluxe Preamp
60-Watt Stereo Amplifier
Stereo Control
25-Watt Amplifier
18-Watt Amplifier
12-Watt Amplifier
FM-AM Tuner
FM Tuner
Speaker Systems
and others

HOBBYIST KITS
"Span-Master" Receiver
"Space-Spanner" Receiver
"Ranger" Radios
"Ocean Hopper" Radio
Clock-Radio
Radio-Intercom
5-Transistor Portable
2-Transistor Pocket Set
2-Way Intercom
Electronic Lab Kits
Photoelectronic System,
and many others

INSTRUMENT KITS
DC VTVM
Volt-Ohm-Milliammeters
5" Oscilloscopes
Tube Checkers
RF Signal Generator
Signal Tracer
Audio Generator
Sweep Generator
Battery Eliminator
Capacity Checker
Transistor Checker
R/C Tester, plus many others

sold exclusively by **ALLIED RADIO**

the Best News in electronic kits for 1960

world's easiest-to-build kits

SAVE UP TO 50%

BEST...by Design!

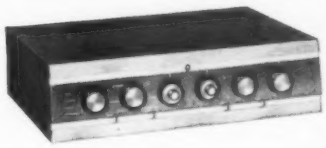
with the exclusive ***knight-kit***

MONEY-BACK GUARANTEE

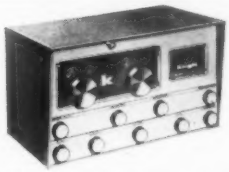
KNIGHT-KITS are an exclusive product of Allied Radio. Every KNIGHT-KIT meets or exceeds published specifications, or we refund your money in full.

BUY ANY KNIGHT-KIT! BUILD IT!
IT MUST PERFORM EXACTLY AS CLAIMED
—OR WE REFUND YOUR MONEY!

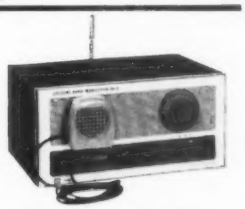
BUILD THE BEST



Y-774 Deluxe 40-Watt Stereo Amplifier (with Center Channel). . **$79.50**
only $5 down



R-100 Amateur Communications Receiver (Hi-gain, with built-in Q-Multiplier). **$104.50**
only $5 down



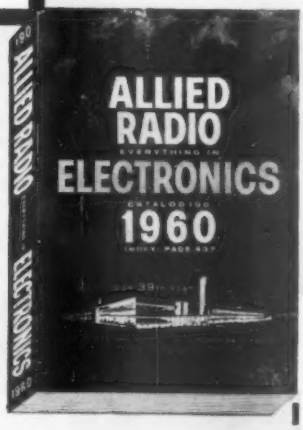
Y-713 Citizen's Band Transceiver. . **$39.95**
only $2 down

only ***knight-kits*** have "CONVENIENCE ENGINEERING" for easiest building...no previous electronic experience needed

Exclusive in Knights-Kits, "convenience engineering" means special attention to every detail: resistors are carded and numbered for easy selection...all parts and hardware are packaged in clear plastic bags for easy identification...wire is precut, stripped, tinned and color-coded to save time... special printed circuitry is used to eliminate complex wiring...all parts are top premium quality...you get everything—even the solder! Finally, Knight-Kit instructions are clear as crystal; step-by-step procedure and wall-sized picture diagrams make assembly a marvel of simplicity. Your final reward is proud enjoyment of the superior performance designed into your Knight-Kit.

SEE THEM HERE

AMATEUR KITS
50-Watt Transmitter
Self-Powered VFO
100 kc Crystal Calibrator
RF "Z" Bridge
Code Practice Oscillator



FREE send for the value-packed 1960 ALLIED CATALOG

Write for the 1960 ALLIED Catalog featuring the complete KNIGHT-KIT line—see the big news in electronic kits—get this leading Buying Guide for everything in Electronics. Send for your FREE copy.

ALLIED RADIO CORP., Dept. 162-K9
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1960 ALLIED Catalog

Name_____

Address_____

City_____ Zone____ State_____

Pioneers in the development of the world's finest electronic kits

our 39th year

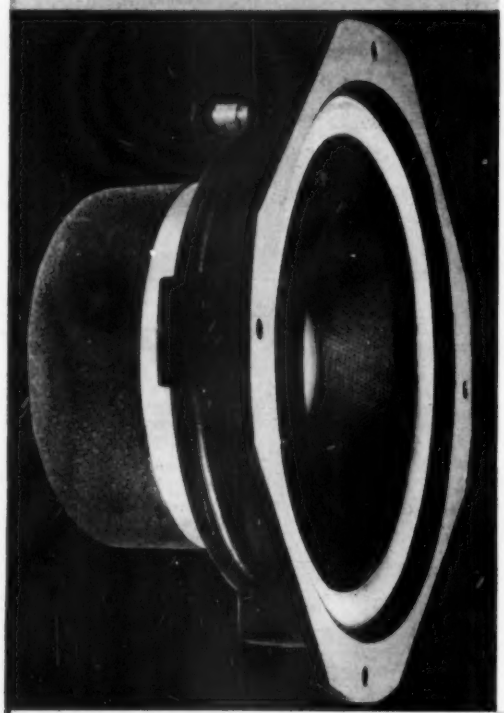
THE WORLD'S LARGEST ELECTRONIC SUPPLY HOUSE

NEW HIGH FIDELITY DRIVERS

of great importance to technicians

JBL

LINEAR-EFFICIENCY PRECISION LOUDSPEAKERS



The new JBL Linear-Efficiency transducer, combining long linear excursion with relatively high efficiency, is engineered for sealed enclosure or infinite baffle installation. It is a development of great significance to the electronic technician because:

...it is an ideal replacement speaker;

...it can be readily mounted in a wall;

...it gives true precision reproduction in the small space frequently required in stereo installations;

...it does not require excessive power for full-range reproduction.

Sound from any existing system, except those employing the very best loudspeakers, can be greatly improved, easily, with the JBL Linear-Efficiency speaker because enclosure dimensions are not critical, and acoustical requirements can be readily met. The mounting flange is designed so that the speaker can be mounted **from the front**, or the rear, of the baffle—wall or enclosure. An enclosed volume of only two cubic feet, or more, is recommended.

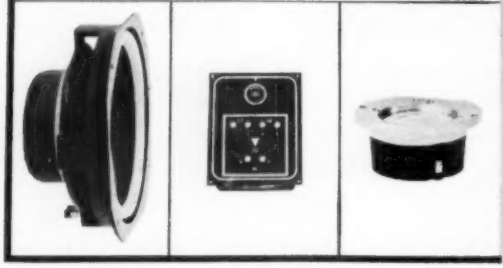
The efficiency of the LE drivers is such that 20 watts is more than sufficient power for home use. However, the dynamic range of these long-throw speakers permits the use of much more powerful amplifiers.

Super 8" JBL MODEL LE8 (illustrated left) shows a flatness of response from 30 to 15,000 c.p.s. that is without precedent in a unit of this size. Impedance: 16 ohms. Flux: 223,500 Maxwells. Power capacity: 20 watts continuous program. Free air cone resonance: 37 c.p.s. Frame: rigid cast aluminum. Baffle hole diameter (front mounting): 7⅛". Shipping weight: 11 lbs.

Write for free technical bulletins

TWO-WAY LINEAR-EFFICIENCY SYSTEM KIT

JBL MODEL S5 includes a super 10" JBL MODEL LE10 Low Frequency Driver with free air cone resonance of 15 c.p.s; JBL MODEL LX3 Dividing Network for crossover at 1,000 c.p.s; JBL MODEL LE30 High Frequency Driver, a 5½ octave direct radiator. These three units form an integrated, perfectly matched, electro-acoustical system; they must be used with each other.



JBL

JAMES B. LANSING SOUND, INC.
3249 Casitas Avenue
Los Angeles 39, California

NEWS BRIEFS *(Continued from p. 10)*

direction of the earth's magnetic field. Information will be gathered on the electron density of the ionosphere and its effects on radio waves. The TV-like scanning device is hoped to produce rough pictures of the earth and its cloud cover. And information will be gathered on the size and speed of micrometeorites (cosmic dust).

Calendar of Events—November

Mid-America Electronics Conference, Nov. 3-5, Municipal Auditorium and Hotel Muehlebach, Kansas City, Mo.

National Automatic Control Conference, Nov. 4-6, Sheraton-Dallas Hotel, Dallas, Texas.

High-Fidelity Music Show, Nov. 6-8, New Washington Hotel, Seattle, Wash.

Radio Fall Meeting, Nov. 9-11, Syracuse Hotel, Syracuse, N. Y.

Instrumentation Conference, Nov. 9-11, Atlanta, Ga.

Annual Electrical Techniques in Medicine and Biology Conference, Nov. 10-12, Penn-Sheraton Hotel, Philadelphia, Pa.

High-Fidelity Music Show, Nov. 13-15, New Heathman Hotel, Portland, Ore.

Conference on Magnetism and Magnetic Materials, Nov. 16-19, Sheraton-Cadillac Hotel, Detroit, Mich.

New England Research and Engineering Meeting, Nov. 17-19, Boston Commonwealth Armory, Boston, Mass.

Nuclear Science National Meeting, Nov. 19-20, Commonwealth Armory, Boston, Mass.

High-Fidelity Music Show, Nov. 20-22, Benjamin Franklin Hotel, Philadelphia, Pa.

SILENT SATELLITES have been detected by three radio amateurs at G-E's Advanced Electronics Center. Theorizing that the ion cloud around a satellite would reflect high-frequency transmissions, they set up radio watch on the 5-, 10-, 15-, and 20-mc transmissions of the Bureau of Standards station WWV.

They made hundreds of observations and demonstrated conclusively that there were three types of disturbances to the usual WWV signals directly attributable to satellites. At 20 mc, there was a fast flutter, similar to the familiar TV "airplane flutter." At 10 and 15 mc, there were two effects, one called "Doppler" because it produced a changing audio tone, despite the fact that such modulation was not on the WWV carrier. This was presumably due to beats between the signal received direct from WWV and that received by reflection from the satellite. The second effect was always delayed by 8 to 10 minutes after each pass of a satellite. This "rumble" contained sound from 60 to 400 cycles which remained steady.

ELECTRONIC REFRIGERATORS reached the patent stage with applications by Philco and Westinghouse for patents on electronic units using the Peltier effect. This allows cooling when current passes through a junction of dissimilar materials, in this case germanium, indium and antimony.

Neither company would say when they expect to produce the electronic, no-moving-parts refrigerators. END

Learn Radio-TV Electronics

by Practicing at Home in Spare Time

Without Extra Charge You Get

special NRI kits developed to give actual experience with Radio-TV equipment. You build, test, experiment with receiver or broadcasting circuits. All equipment yours to keep.

Have High Pay, Prestige, Good Future as a Skilled Radio-TV Electronic Technician

People *look up to* and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a Radio-TV Electronic Technician. At home, and in your spare time, *you* can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere *here* in the fast growing Radio-TV Electronic field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

Increasing Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Radio-Television Electronic Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. Color TV, Hi-Fi is growing. The hundreds of Radio and TV Stations on the air offer interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time Radio-Television sales and service businesses—enjoy security.

Act Now—See What NRI Can Do for You

NRI has devoted over 40 years to developing simplified practical training methods. You train at home in spare time. Get practical experience, learn-by-doing.

NATIONAL RADIO INSTITUTE
Washington 16, D.C.

NRI Has Trained Thousands for Successful Careers in Radio-TV

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Georgia.

Has Good Part Time Business
"Early in my training I started servicing sets. Now have completely equipped shop. NRI is the backbone of my progress." E. A. BREDA, Tacoma, Washington.

SEE OTHER SIDE

Cut Out and Mail This Card—No Stamp Needed

Sample Lesson and Catalog Both Sent FREE

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

Dept. EF , Washington 16, D.C.

Please send me sample lesson of your Radio-Television Training and Catalog FREE. (No salesman will call.)

Name..... Age.....

Address.....

City..... Zone..... State.....

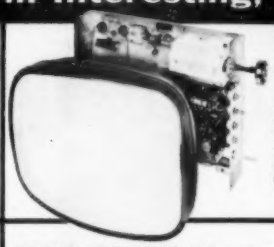
ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

NRI SUPPLIES LEARN-BY-DOING KITS WITHOUT EXTRA CHARGE

Technical Know-How Pays Off in Interesting, Important Work

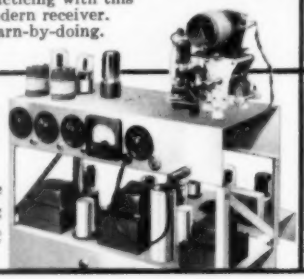
YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



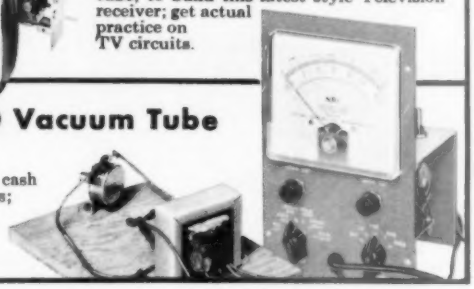
YOU BUILD This 17 Inch Television Receiver

As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits.



YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.



YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs Be a Radio-TV Electronic Technician

Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Radio-Television school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with N R I Course. Clearly written, well-illustrated NRI lessons teach Radio-TV Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Graduates Do Important Work

Now Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. Favaloro, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. Cressey, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA - TV." J. F. Meling, NewYork, N.Y.

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D.C.

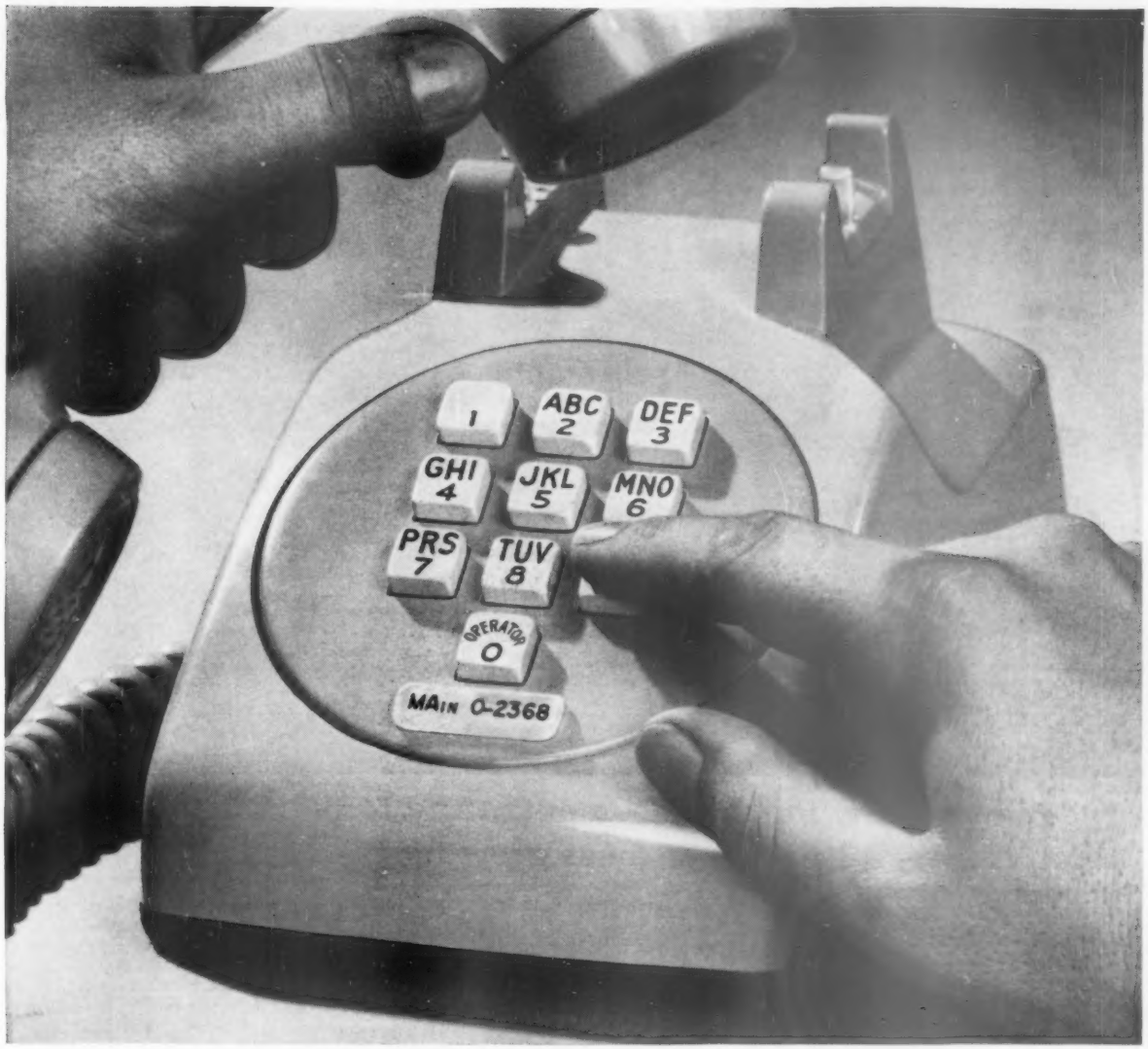
BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
3939 Wisconsin Avenue
Washington 16, D.C.

SAMPLE LESSON
64-page CATALOG
both FREE

SEE OTHER SIDE



NEW EXPERIMENT IN TELEPHONY

It could speed up "dialing." Bell Laboratories people created it—and now it's being tested.

The telephone you see above embodies an important new concept. It "dials" by means of push buttons—promises more convenient telephoning. Bell System engineers are currently testing it for public reaction. Bell Telephone Laboratories developed it.

The Laboratories' invention of the transistor makes it possible. For the transistor permits a new kind of calling signal generator, mounted within the instrument.

To insure ease of operation, psychologists studied human reactions to various finger pressures and sizes and arrangements of buttons. All factors affecting speed and accuracy were thoroughly evaluated. Electrical and mechanical engineers brought together the human and physical factors, created a practical piece of apparatus. Industrial designers worked out the functional shape.

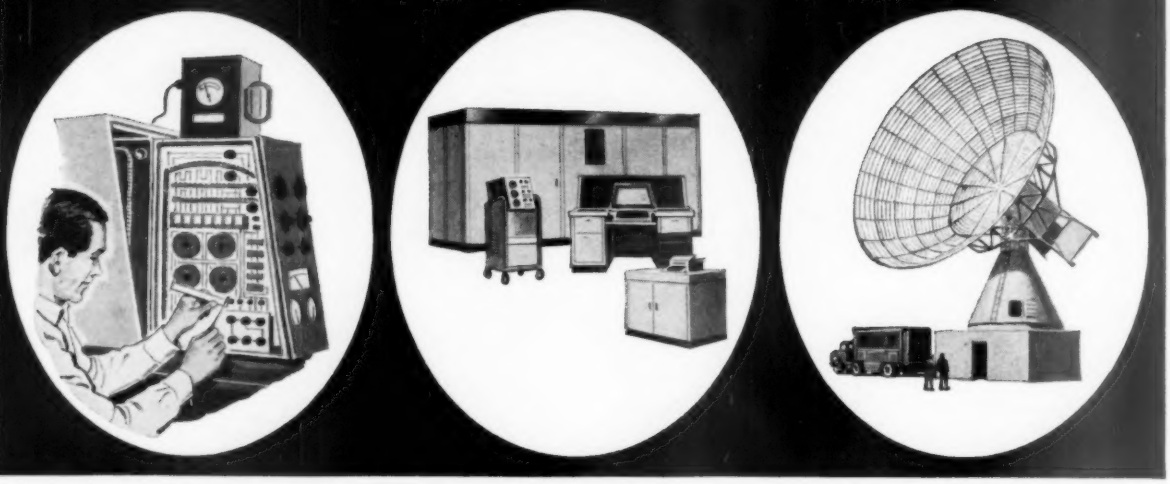
The new instrument sends a calling signal quite different from that of your present telephone. This poses a problem. Complex automatic switching must be changed to handle the new signals as well as the old ones. Switching engineers must devise ways to make this change in *thousands* of central offices—economically.

Most of the challenges have been met. Final judgment on this new concept depends on the outcome of field tests. Meanwhile, Bell Laboratories continues in its task of originating and developing devices to improve your Bell System telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Learn TRANSISTOR, COMPUTER OR RADAR TECHNOLOGY at home



Prepare now for advancement... and for a secure and profitable career in one of these growing fields of electronics

CHOOSE FROM 7 PROVEN COURSES

1. **SEMICONDUCTORS**—Transistor Principles and Practices. Learn Theory, construction, application of all types of transistors.
2. **PRINCIPLES OF RADAR CIRCUITS AND EQUIPMENT**—Introduction to, and detailed study of radar fundamentals.
3. **RADAR SYSTEMS PRINCIPLES AND PRACTICES (Advanced Level)**—Applications of radar components, systems, design . . . performance measurement.
4. **INTRODUCTION TO ANALOG COMPUTERS**—Covers theories and fundamentals of all makes of analog computers.
5. **ANALOG COMPUTER SYSTEMS (Advanced Level)**—Covers the analog system concepts and methods.
6. **AUTOMATIC DIGITAL COMPUTERS**—Digital computer theory, maintenance, installation, basic programming.
7. **PROGRAMMING FOR DIGITAL COMPUTERS**—Covers encoding, set-up and operation.

MAIL COUPON TODAY FOR FREE INFORMATION

PHILCO TECHNOLOGICAL CENTER TCR-4
22nd and Lehigh Ave., Phila. 32, Pa.
Please send full information on subjects checked below. (No obligation)

- ☐ 1. Semiconductors
- ☐ 2. Principles of Radar
- ☐ 3. Radar Systems
- ☐ 4. Intro. to Analog Comp.
- ☐ 5. Analog Comp. Systems
- ☐ 6. Automatic Digital Comp.
- ☐ 7. Programming for Digital Computers

NAME_____
COMPANY_____ POSITION_____
ADDRESS_____
CITY_____ STATE_____

Expand your knowledge in one of these rapidly advancing fields of electronics and you'll be set for a secure and profitable future. Transistor technology is becoming one of the biggest fields in electronics. The use of automatic computers in automated factories, business offices and military systems is outpacing the technical manpower needed to build and maintain them. New developments in radar have given new life to this dynamic field. Electronics men are in demand, but it takes specialists to land the big jobs. Now's the time to prepare . . . advance and prosper in this new era.

Learn with proven home study courses from the Philco Technological Center. Get a practical, working knowledge with proven courses developed by specialists in electronics and training . . . men who know the kind of knowledge you need. Philco Technological Center is a department of Philco TechRep Division, one of the world's leading field engineering organizations.

NOW READY—A special computer programming course that covers all important techniques of encoding and operation . . . ideal for maintenance men, or those who wish to become Programmers.

Send for full details. No salesman will call.

PHILCO®
TECHNOLOGICAL
CENTER
22nd and Lehigh Ave.
Philadelphia 32, Pa.

COYNE'S New Complete

Pin-Point TROUBLE SHOOTING Series

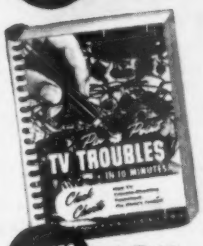
Takes the Headaches Out of ALL Servicing Problems!

NOW! See Complete Series on 7-Day FREE TRIAL!

BRAND NEW! $5.95

Pin-Point TRANSISTOR TROUBLES IN 12 MINUTES

The only handbook that covers practical circuitry and trouble-shooting for ALL transistorized equipment! 525 pages; hundreds of photos, illustrations, diagrams; 120 famous Check-Charts; valuable reference sections; special test procedures to quickly locate ANY trouble!



SAVES TIME! $3.95

Pin-Point TV TROUBLES IN 10 MINUTES

Your most useful on-the-job "tool"! Quickly and easily pin-points the exact trouble in any TV set. Covers 70 symptoms, 700 trouble spots. Over 300 cross-indexed pages; 50 time-saving Check-Charts; 290 diagrams and photos; explanation of circuits and designs.

EASY TO USE! $5.95

Pin-Point COLOR TV TROUBLES IN 15 MINUTES

Time-saving troubleshooting methods for COLOR TV video and audio problems! Pin-point every type of trouble quickly and accurately. Covers every type of color picture tube in use, including single and 3-gun, round and rectangular. 550 pages; 362 Check-Charts, diagrams and photographs, including picture patterns of COLOR TV troubles!

NOTHING LIKE IT! $3.95

Pin-Point RECORD CHANGER TROUBLES IN 5 MINUTES

Locate record-changer mechanical and electronic troubles FAST! Covers every American make, most foreign makes of hi-fi; single, three and four speed changers. Helps spot audio troubles, too! Over 320 pages; 450 illustrations; 58 handy Check-Charts!

Here's What Enthusiastic Servicemen Say!

"I cannot see for the life of me how you can manage to include so much information in these books at such unbelievably low prices.
H. L. Grotjahn, New York

"Your book, 'Pin-Point Record Changer Troubles' is a must in every serviceman's library."
Roy V. Hill, Kansas City, Mo.

"Received your TV book and want to say I would not part with it for $500 if I could not get another copy."
Clyde H. Young, East St. Louis, Ill.

Famous Check-Chart Handbooks Save You Valuable Time!

These amazing Pin-Point books show you how to find the trouble in *any* TV, record-changer or transistor circuit FAST! Simple cross-index tells you in what section you'll find cause of trouble. Handy Check-Charts then help you accurately locate the EXACT trouble spot. Cut waste time, eliminate hours of aggravation, get right to the heart of trouble in minutes!

Use These Books Right On The Job—No Need To Memorize!

These Pin-Point books are designed especially for on-the-job trouble-shooting. You simply turn to the indexed section, locate the circuit description and Check-Chart, and in minutes you have the trouble spot located and ready for repair. No complicated theory or mathematics. Down-to-earth, practical circuit description, service methods and trouble-shooting techniques. Published by the famous Coyne Electrical School and approved by leading authorities in the field.

Send No Money—FREE 7-Day Trial Offer!

You must *see* these sensational new books to fully appreciate how much time and trouble they can save you. That's why we want you to use any or all of them for a full week, without obligation! Send no money, just fill out and mail the coupon. We'll rush the books you want on FREE TRIAL. After 7 days, send only the low price, or return books and pay nothing. If you want all 4 books, send only $3.00 after 7 days and $3.00 a month until $19.80 plus shipping is paid. Cash price after 7 days trial—$19.80 (you save shipping). No interest, no carrying charges, no risk. Take advantage of this offer NOW!

COYNE ELECTRICAL SCHOOL 1501 W. Congress Pkwy., *Educational Book Publishing Division* Dept. A9-T1, Chicago 7, Ill.

VALUABLE FREE GIFT!

JUST EXAMINE THIS SERIES AT NO RISK! Ask to examine all 4 of COYNE'S amazing trouble-shooting books on a 7-day FREE TRIAL basis, and we'll send you a valuable money-making book, "BIGGER PROFITS IN TV" absolutely FREE! Sells for $1.50; yours FREE whether you keep the 4 books or not. Mail coupon NOW!

COYNE Pin-Point TROUBLE SHOOTING PUBLICATION

FREE TRIAL OFFER...Mail Coupon NOW!

Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL, Dept. A9-T1
1501 W. Congress St., Chicago 7, Ill.

☐ Rush complete 4-book PIN-POINT series for 7-day free trial as offered, plus FREE copy of "BIGGER PROFITS IN TV"!
If you want just part of the series check books below.

☐ RECORD CHANGER ($3.95 plus postage)
☐ TRANSISTORS ($5.95 plus postage)
☐ COLOR TV ($5.95 plus postage) ☐ TV ($3.95 plus postage)

Name ..... Age .....

Address .....

City ..... Zone ..... State .....

☐ Check here if you enclose full price; we'll pay postage. 7-day money-back guarantee.

Is the stereo pickup you bought today already

OBSOLETE?

Because a stereo record is far more difficult to reproduce faithfully than a mono disc, you may know that a stereo pickup should **combine** small dynamic mass, high vertical and lateral compliance, low distortion, good channel separation, excellent transient response, and wide frequency range.

But do you know that faithful stereo reproduction **also** requires that the cartridge have:

- Exactly **the same** frequency response on a vertical test recording as on a lateral disc containing the same material...
- Precisely **the same** dynamic mass and compliance in both vertical and lateral operation...
- Inherently **linear** generating elements...
- Complete **independence** of the two generating elements?

Most stereo pickups fail to meet one or more of these essential requirements, yet the ESL Gyro/Jewel perfectly meets **all** of these requirements.

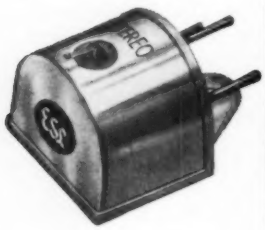
No matter how new or how respected your stereo pickup may be, the chances are that ESL's advanced design has **already** made it obsolete.

Join the musicians, engineers, and music lovers who have changed to the stereo cartridge that's **years ahead**: the ESL Gyro/Jewel. Only $69.95 at your audio dealer's.

FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.

Dept E • 35-54 36th Street
Long Island City 6, NY



Premium Hi-Fi APPROVED by HIGH FIDELITY CONSUMER'S BUREAU OF STANDARDS

Correspondence

STEREO MIKING

Dear Editor:

Chester Santon's preference for close-miking technique for stereo recording (page 41, August) compels me to disagree. . . . I don't challenge his right as a critic to approve it in print, but some voice (mine, in this case) must cry from deep in the wilderness, "It ain't right!"

For example, take Mr. Santon's comment on the Van Cliburn concert-recorded version of Rachmaninoff's *Third*. It's a fine performance, but the miking, at least in the copy I heard, gave the ridiculous impression that Van, his piano and the Symphony of the Air were all housed in a coat closet or a shoe-box. Not even the performers heard that performance with the lack of reverberation that we are expected to accept. I will not buy such a poor recording. I doubt that the miking was planned to be, "ideal for the small-scaled concept of the work."

A hall with "good" acoustics is not dead like radio studios of the 30's and 40's. It has a highly specific type of reverberation that lasts for 2 to 3 seconds. Exclude if you will 300 years of musical experience and say that now, with modern recording, we have a "new sound." Certainly recordings cannot re-create realism; they can only create the illusion of realism. But music recorded with the right reverberation will sound right and real.

E. D. HOAGLAN

Omaha, Neb.

My general comments at the beginning of the August column were not an endorsement of the Van Cliburn miking. In that recording, the conductor holds the orchestra to a whisper in some passages. With a capacity crowd in the hall, normal mike placement was abandoned, not as part of any trend referred to in my preliminary remarks, but as a safeguard against excessive audience noise.

Even under normal recording conditions, further improvements in the stereo disc may provide greater latitude in mike placement.—*Chester Santon*

DISPUTES CROWHURST

Dear Editor:

Regarding Mr. Crowhurst's article on stereo broadcasting (July issue), I take exception to his statement that the Burden system does not and can-

Is the stereo arm you bought today already

OBSOLETE?

Because a stereo record is far more difficult to reproduce faithfully than a mono disc, you may know that so-called stereo arms made by simply inserting additional wiring in mono arms are extremely unlikely to prove satisfactory for stereo use.

Faithful stereo reproduction requires an arm expressly designed for the exacting requirements of the stereo disc:

- Perfect stylus contact must be maintained with both sides of the record groove, regardless of turntable leveling...
- Vertical force must be kept to four grams or less, to avoid excessive distortion of the record material by the stylus...
- Ball bearings should be used throughout for all vertical and horizontal motions...
- No resonance should exist in the audio range.

Most arms fail to meet one or more of these essential requirements. **Only** the ESL Gyro/Balance perfectly meets all of these requirements.

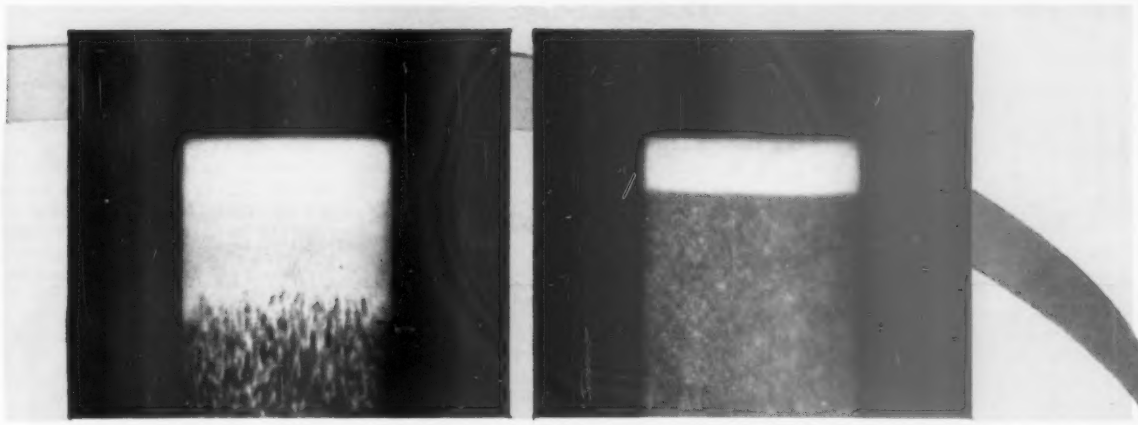
No matter how new or how respected your stereo arm may be, the chances are that ESL's advanced design has **already** made it obsolete.

Join the musicians, engineers, and music lovers who have changed to the stereo arm that's **years ahead**: the ESL Gyro/Balance. Only $34.95 at your audio dealer's.

FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.

Dept E • 35-54 36th Street
Long Island City 6, NY



Inherent physical superiority of Sylvania's exclusive Sarong cathode, right, over a conventional cathode, left, is evident in this photomicrograph comparison. The texture, thickness, sharp coating edges and overall uniformity of Sarong represent major improvements in the heart of the electron tube never before achieved in mass production.

Only Sylvania has SARONG—

the revolutionary new receiving tube cathode that means better service profits

Fewer call-backs due to intermittents and shorts . . . reduced noise and less arcing...these are some of the benefits available to you *now* with this "can't be copied" Sylvania development.

The Sarong cathode is a completely new development that transforms conventional sprayed cathode coating into a thin uniform film, precision-wrapped and securely bonded, around each cathode sleeve.

Now in use in nearly 1 million receiving tubes, Sylvania Sarong is a field-proven development setting new standards of efficiency and quality in electron tube performance.

First tubes to incorporate Sarong are tv tuner types 6BZ7, 6BQ7A, 6BC8 and 6BS8. Eventually Sarong cathodes will be utilized in a full line of Sylvania receiving tubes.

Here's why it will pay your dealers to replace with Sylvania Sarong cathode tubes:

- Reduced noise . . . uniformity in spacing has resulted in improved noise level up to 0.6 db for TV frequencies.
- Less heater-cathode leakage . . . Sarong is flake-resistant and smooth textured. No stray coating particles to stick inside cathode.
- Greater tube ruggedness against shock and vibration because of Sarong's superior coating adhesion.
- Reduced cathode-grid shorts, intermittent short circuits, and less arcing due to controlled uniformity of Sarong thickness. Sarong cathode coating is held to thickness tolerances five times closer than conventional sprayed cathode coating.

Sylvania Sarong will help you make better profits through reductions in call-backs. See your Sylvania representative today for the full story on Sarong—available *only* from Sylvania.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: P. O. Box 1190, Station "O," Montreal 9.

Sarong cathodes are now in use in four Sylvania tv tuner types. Eventually all Sylvania receiving tubes will contain Sarong cathodes.

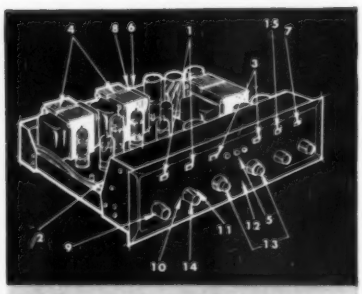
SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

3 NEW STEREO AMPLIFIERS FROM H.H. SCOTT

299
40 Watt
Stereo Amplifier
$199.95*

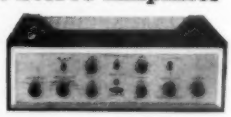
Third Channel Output, Separate Tone Controls Make These The Most Versatile Amplifiers You Can Buy!

H. H. Scott's 299 Stereo Amplifier has been acclaimed "world's most versatile" by editors of all leading hi fi magazines. Like all H. H. Scott stereo amplifiers, it includes a third channel to give optimum realism in stereo playback and a signal for driving extension speak systems. Other advanced features include special balancing facilities and *separate* tone controls on each channel to let you adjust for tonal differences in speakers and room acoustics.



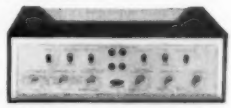
1. Provision for connecting two phono cartridges. 2. D.C. Filament supply to virtually eliminate hum. 3. Separate record scratch and rumble filters. 4. Dual 20 watt power stages. 5. Visual signal light panel. 6. Stereo tape recorder output. 7. Phase reverse switch. 8. Third channel output. 9. Compensation for direct connection of tape playback heads. 10. Special switching to use your stereo pickup on monophonic records. 11. Play a monophonic source through both channels simultaneously. 12. Can be used as an electronic crossover. 13. Completely separate Bass and Treble controls on each channel. 14. Special balancing circuit. 15. Loudness compensation. Specifications: Distortion (first order difference tone) less than 0.3%. Frequency Response: 20 cps to 30,000 cps. Harmonic Distortion: 0.8% at full power output. Noise and Hum: Hum better than 80db below full power output; noise equivalent to 10 microvolts on low level input.

222 24 Watt Stereo Amplifier



This budget priced stereo amplifier has such features as Third Channel Output and separate tone controls usually found only in much more expensive equipment. It is backed by H. H. Scott's reputation for quality and engineering leadership. $139.95*

130 Stereo Preamplifier



All the features of the 299 plus many more. Used where it is desired to separate heat producing power amplifiers from control location or where higher power is required than available in integrated amplifiers. $169.95*

*Slightly higher West of Rockies. Accessory case extra.

H. H. SCOTT

H.H. Scott, Inc. 111 Powdermill Road, Dept. RE-10 Maynard, Mass.

Rush me new catalog and complete technical specifications on all new H. H. Scott components.

Name.....

Address.....

City.....State.....

Export: Telesco International, 36 W. 40th St., N.Y.C.

HEAR THE FABULOUS LONDON-SCOTT INTEGRATED STEREO ARM AND CARTRIDGE

not work. I also question the mathematics in his article. These are not the figures published by Burden Associates.

I have personally heard the Burden Phantodyne system perform and I noticed no audible effect on the stereo signals. The listening quality for monophonic reception of a single stereo channel, too, was of excellent quality. Both the Burden and the Becker (Bell Telephone) systems are compatible with all forms of mono and stereo transmission including multiplexing, FM–AM, FM–FM and TV–FM–AM systems.

LAWRENCE S. SCHENCK
Station WVIP,
Mount Kisco, N. Y.

ORGAN TUNING

Dear Editor:

Mr. Jaski's article "Servicing Electronic Organs" (August RADIO-ELECTRONICS) was timely, and I enjoyed reading it until the paragraphs on organ tuning. To really make an organ sing, the following table should be employed. This uses the authentic equal-tempered scale in six places, and the beats are calculated in a circle of fifths based upon middle C:

Fifth	*Beats/sec*	*Beats/10 sec (all flat)*
C —G	0.888	9
C#—G#	0.953	10
D —A	0.995	10
D#—A#	1.053	10 or 11
E —B	1.118	11—12
F —C	1.142	12
F#—C#	1.252	13
G —D	1.325	14
G#—D#	1.407	14
A —E	1.490	15
A#—F	1.580	16
B —F#	1.671	17
C —G	(next octave higher)	18

If the fifths are tuned perfectly around the circle, you'll wind up with a horrible 7 cycles per second beat and have no place to squeeze it in. An organ tuned in this way is suitable only for boogie and picket-fence rhythm—harmony is not considered.

SEVERN GLADEM
Dayton, Ohio.

TRANSISTOR FICTION ?

Dear Editor:

In Mr. Louis Garner's "Transistors—Fact and Fiction" (p. 48, July) he neglects to tell us that one common circuit, the class-B output stage in the common-emitter configuration, is prone to damage by reversing of the battery.

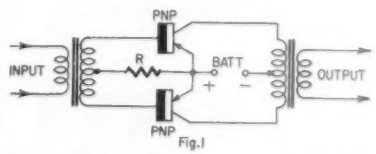


Fig. 1

He states, "with the common-emitter configuration, reversing battery polarity will not damage the transistor."

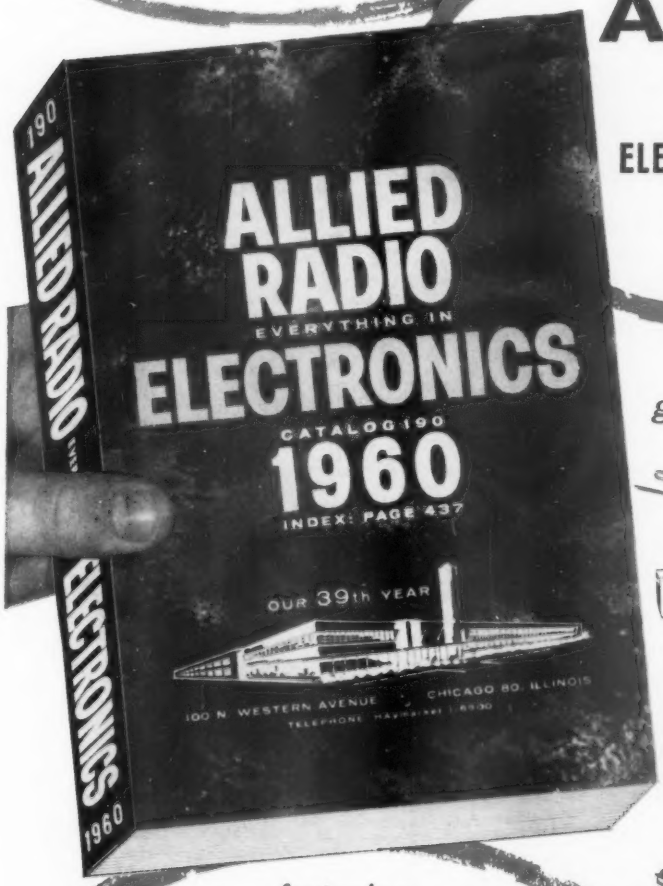
Looking at the circuit (Fig. 1), we

FREE

ALLIED'S 1960

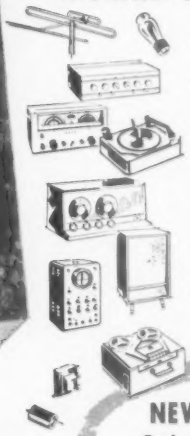
ELECTRONIC SUPPLY CATALOG

it's value-packed... send for it!



your complete money-saving guide to everything in electronics

WORLD'S LARGEST STOCKS



- Latest Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS for Every Need
- Values in Recorders and Supplies
- Latest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

NEW LOW EASY PAY TERMS

Only $5 down (or less) on orders up to $200. Up to 24 months to pay. Fast handling—no red tape.

featuring these **ALLIED** *exclusives:*

MONEY-SAVING KNIGHT-KITS®—the very best in build-your-own electronic equipment—designed to save you up to 50%. "Convenience Engineered" for easiest assembly; the only kits covered by Money-Back Guarantee. Complete selection of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

KNIGHT® STEREO HI-FI—truly "honored for value"—the best you can buy, yet far lower in cost. Select super-value KNIGHT components or complete systems and save most. Also see the world's largest selection of famous name hi-fi components and money-saving ALLIED-recommended complete systems.

Get every buying advantage at ALLIED: lowest money-saving prices, fastest shipment, expert personal help, guaranteed satisfaction...

send for the leading electronic supply guide

FREE

ALLIED RADIO CORP., Dept. 2-K9
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1960 ALLIED Catalog.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

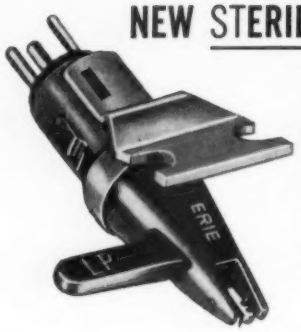
ALLIED RADIO

our 39th year

World's Largest Electronic Supply House

Full dimensional stereo at bargain STERIEO prices...

NEW STERIEO CERAMIC CARTRIDGE



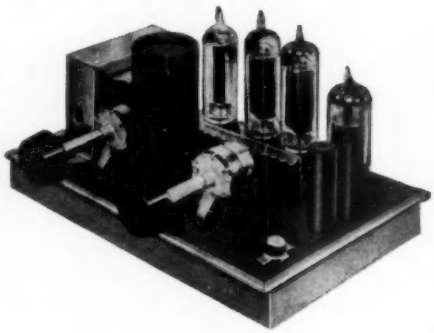
This high quality single-element stereophonic cartridge is just what you need to convert your monaural record player to stereo. Dual stylii. High frequency response: 20 to 16,000 cps. Excellent channel separation: 20 DB. Low tracking force: only 5-6 grams. Easy to install. Complete with adapter. *Regular list price . . .*

$8.95

PLUS PHONO AMPLIFIER KIT

The second step to wonderful stereophonic sound is this high-quality, four tube push-pull Erie amplifier. It's a complete-in-one-box do-it-yourself kit. Quick and easy to assemble because of printed circuit board and plug-in components. *Regular list price...*

$12.95



For the first time—two unbeatable stereo components at a price everyone can afford. If you want to enjoy the full dimensions of music, you won't want to pass up this bargain—a $21.90 value for only $14.95. See your audio dealer soon. Offer expires November 15, 1959.

BOTH FOR ONLY $14.95

For name of your nearest Erie Distributor, write to:

ERIE Electronics Distributor Division
ERIE RESISTOR CORPORATION
Erie, Pennsylvania

see R, which is only a few ohms, and is often omitted entirely, as the only protection. It is usually too small to save the transistor. Redrawing the circuit (Fig. 2), shows the biasing for one side of the stage clearly.

Voltage is applied across the base-

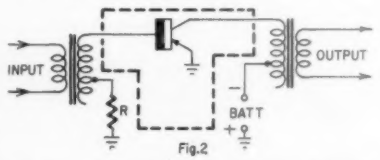


Fig.2

collector junction, as shown by the dotted line, in the reverse direction. If the battery polarity is reversed, the collector junction will conduct; both transistors will instantly burn out (some manufacturers, but not many, protect against this by inserting a small diode in series with R).

Whitehorse, Yukon, Canada — JIM BUTTERFIELD

I concede that—*using the circuit Mr. Butterfield has supplied*—reversing the battery polarity will generally blow the transistors. However, commercial circuits are almost always class AB, not B, as he suggests; they almost *always do* have the resistor R, which he says is often omitted; base bias is *almost always* supplied by a voltage divider, and the circuit example I used was a single-ended, not a push-pull, stage. I tried reversing battery polarity in about a dozen transistor sets. I didn't ruin a single transistor, although in three cases very close to overload current was drawn by the output stage.

Finally, I referred to the statement "Reversing polarity will ruin transistors" as a *half-truth*—I didn't say it was always wrong.

As I also said in the sentence Mr. Butterfield has taken me to task for, "It is still a good idea to observe battery polarity."—*Lou Garner*

A CORRECTION

Dear Editor:

I have just received my August RADIO-ELECTRONICS and I fear that if your readers go by the drawing only, some of them may get the wrong notion about how to make the test I described in the last paragraph on page 39, as by some accident the drawing does not convey exactly what I meant.

When I said, "Stretch a single layer of cotton handkerchief across your mouth," I meant stretched *across* (not away from) the mouth. Imagine you are gagging yourself, or that you are a nurse wearing a microbe filter. The test material must be stretched across the mouth so tightly that no air can escape *except* through the sample. You can then feel by the differences in back pressure just how some materials resist the flow of air while others offer negligible resistance.

Toronto, Canada — P. G. A. H. VOIGT

END

WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID
RADIO-TELEVISION SERVICE TECHNICIAN

NOW – Just $6 Starts You Training in

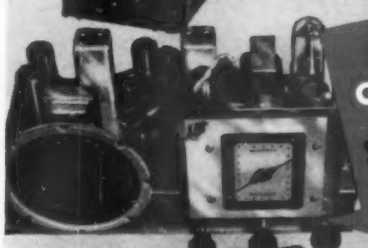
RADIO-TELEVISION

the SPRAYBERRY "Learn-by-Doing" Way . . .

25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!

- The new Sprayberry Training Television Receiver, built and tested in 5 sections.
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.



Big New CATALOG AND Sample Lesson FREE!

You build the new Sprayberry tester—a complete 18-range Volt-Ohm-Milliammeter test meter.

★ ★ ★ ★ **This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!**

Men by the thousands... trained Radio-Television Service Technicians...are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now—*just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need...to step into a fine job or your own Radio-Television Service Business.

Complete Facts Free—Act Now; Offer Limited

Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once...mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free.* No obligation...no salesman will bother you.

HOME STUDY TRAINING IN SPARE TIME

Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today... let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity that's in store for you!

SPRAYBERRY Academy of Radio-Television
1512 Jarvis Avenue, Dept. 20-C, Chicago 26, Illinois

Mail This Coupon Now—No Salesman Will Call

Sprayberry Academy of Radio-Television
Dept. 20-C, 1512 W. Jarvis Ave., Chicago 26, Ill.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... Age.....

ADDRESS.....

CITY..... ZONE.....STATE.....

Early American Model,
in fruitwood,
30" wide, 24¾" high, 13⅛" deep.
$279.95 user net.

Furniture courtesy of Lopipero Inc.

Containing two complete multi-speaker systems in one compact enclosure, the 'Trimensional' TMS-2 projects frequencies of both channels to the rear and side walls of the room. Thus, one large wall area becomes channel A; another channel B... exactly as if you had a series of widely distributed speakers for each channel.

TMS-2... most sensational advance in stereo reproduction

When you listen to the TMS-2, you will experience stereophonic reproduction that no conventional system can ever achieve. Its entirely new principle of operation permits every listener *throughout* the room to enjoy fully balanced sound with such extraordinary breadth and three-dimensional depth that it seems to originate beyond the confines of the room itself. Full controls and adjustable doors allow the 'Trimensional' TMS-2 to be placed *anywhere* – along wall or corner – without affecting its performance capabilities. The full TMS-2 story is a fascinating one. Write for it today.

University®

Furniture courtesy of Jens Risom Design Inc.

Contemporary Model,
30" wide, 25" high, 12½" deep.
In mahogany – $258.00,
in blond or walnut – $263.00 user net.

***WRITE DESK** J-6, UNIVERSITY LOUDSPEAKERS, INC., WHITE PLAINS, N. Y.*

In STEREO and Mono Hi-Fi . . . the experts say your best buy is EICO®

"The overall design of the HF-81 is conservative, honest and functional. It is a good value considered purely on its own merits, and a better one when its price is considered as well."
— Hirsch-Houck Labs (HIGH FIDELITY Magazine)

- Advanced engineering • Finest quality components
- "Beginner-Tested," easy step-by-step instructions
- LIFETIME service & calibration guarantee at nominal cost
- IN STOCK — compare, then take home any EICO equipment — right "off the shelf" — from 1500 neighborhood EICO dealers.

Stereo Amplifier-Preamplifier HF81

Stereo Preamplifier HF85

70W Stereo Power Amplifier HF87
28W Stereo Power Amplifier HF86

FM Tuner HFT90
AM Tuner HFT94

Stereo Integrated Amplifier AF4

12W Mono Integrated Amplifier HF12
Other Mono Integrated Amplifiers:
50, 30, & 20W (use 2 for stereo)

2-Way Bookshelf
Speaker System HFS1
3-Way Speaker System HFS3
2-Way Speaker System HFS5

Over 1 MILLION EICO instruments in use throughout the world.

Add 5% in the West.

HF81 Stereo Amplifier-Preamplifier selects, amplifies, controls any stereo source & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Provides 28W monophonically. Ganged level controls, separate balance control, independent bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers. **"Excellent"** — SATURDAY REVIEW; HI-FI MUSIC AT HOME. **"Outstanding quality . . . extremely versatile."**—ELECTRONICS WORLD LAB-TESTED. **Kit $69.95. Wired $109.95.** Includes cover.

HF85 Stereo Preamplifier is a complete, master stereo preamplifier-control unit, self-powered for flexibility & to avoid power-supply problems. Distortion borders on unmeasurable even at high output levels. Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phono, tape head, mike, AM, FM, & FM-multiplex. One each auxiliary A & B input in each channel. Switched-in loudness compensator. **"Extreme flexibility . . . a bargain."**— HI-FI REVIEW. **Kit $39.95. Wired $64.95.** Includes cover.

New HF87 70-Watt Stereo Power Amplifier: Dual 35W power amplifiers of the highest quality. Uses top-quality output transformers for undistorted response across the entire audio range **at full power** to provide utmost clarity on full orchestra & organ. IM distortion 1% at 70W, harmonic distortion less than 1% from 20 to 20,000 cps within 1 db of 70W. Ultra-linear connected EL34 output stages & surgistor-protected silicon diode rectifier power supply. Selector switch chooses mono or stereo service; 4, 8, 16, and 32 ohm speaker taps, input level controls; basic sensitivity 0.38 volts. Without exaggeration, one of the very finest stereo amplifiers available regardless of price. Use with self-powered stereo preamplifier-control unit (HF85 recommended). **Kit $74.95. Wired $114.95.**

HF86 28W Stereo Power Amplifier **Kit $43.95. Wired $74.95.**

FM Tuner HFT90: Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision **eye-tronic®** traveling tuning indicator. Sensitivity: 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence. Very low distortion. **"One of the best buys in high fidelity kits."** — AUDIOCRAFT. **Kit $39.95*. Wired $65.95*. Cover $3.95.** *Less cover, F.E.T. Incl.

New AM Tuner HFT94. Matches HFT90. Selects "hi-fi" wide (20c — 9kc @ —3 db) or weak-station narrow (20c — 5kc @ —3 db) bandpass. Tuned RF stage for high selectivity & sensitivity; precision **eye-tronic®** tuning. Built-in ferrite loop, prealigned RF & IF coils. Sensitivity 3 uv @ 30% mod. for 1.0 V out, 20 db S/N. Very low noise & distortion. High-Q 10 kc whistle filter. **Kit $39.95. Wired $69.95.** Incl. Cover & F.E.T.

New AF-4 Stereo Amplifier provides clean 4W per channel or 8W total output. Inputs for ceramic/crystal stereo pick-ups, AM-FM stereo, FM-multi stereo. 6-position stereo/mono selector. Clutch-concentric level & tone controls. Use with a pair of HFS-5 Speaker Systems for good quality, low-cost stereo. **Kit $38.95. Wired $64.95.**

HF12 Mono Integrated Amplifier provides complete "front-end" facilities and true high fidelity performance. Inputs for phono, tape head, TV, tuner and crystal/ceramic cartridge. Preferred variable crossover, feedback type tone control circuit. Highly stable Williamson-type power amplifier circuit. Power output: 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Includes cover.

New HFS3 3-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.), 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26½", 13⅞",14⅜". Unfinished birch **$72.50.** Walnut, mahogany or teak **$87.95.**

New HFS5 2-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, ⅝" excursion, 8" woofer (45 cps res.), & 3½" cone tweeter. 1¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 45-14,000 cps clean, useful response. HWD: 24", 12½", 10½". Unfinished birch **$47.50.** Walnut, mahogany or teak **$59.50.**

HFS1 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. 8 ohms. HWD: 23" x 11" x 9". Price **$39.95.**

LGS-1 Brass Tip Matching 14" Legs — $3.95.

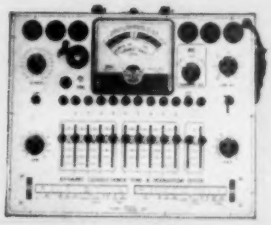
HFS2 Omni-Directional Speaker System (not illus.) HWD: 36", 15¼", 11½". **"Eminently musical"** — HIGH FIDELITY. **"Fine for stereo"** — MODERN HI-FI. Completely factory-built. Mahogany or walnut **$139.95.** Blond **$144.95.**

IMPORTANT NOTE: All EICO kits built according to our instructions, and all EICO factory-assembled equipment, conform to the high standards and specifications as published in EICO literature and advertisements. All EICO factory-assembled equipment is completely and meticulously **hand-wired throughout** — no printed circuitry; **each factory-assembled unit is 100% final-tested throughout for each feature and function — no "spot" or "partial" checking. In EICO's final-test techniques, nothing is left to chance.**

Fill out coupon on other side for FREE CATALOG
See and hear the complete EICO line at the IHFM HI-FI SHOW, Booths 305 & 306.

Copyright 1959 by Electronic Instr. Co., Inc. 33-00 N. Blvd., L. I. C. 1, N. Y.

The specs prove it...your best buy is EICO®



A
DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
KIT $69.95 WIRED $109.95
Complete with steel cover & handle

B
TV-FM SWEEP GENERATOR AND MARKER #368
KIT $69.95 WIRED $119.95

C
RF SIGNAL GENERATOR #324
KIT $26.95 WIRED $39.95

D
PEAK-TO-PEAK VTVM #232 & UNIPROBE (pat. pend)
KIT $29.95
WIRED $49.95

E
COLOR & MONOCHROME DC TO 5 MC LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95 WIRED $129.50
5" PUSH-PULL Oscilloscope #425: Kit $44.95 Wired $79.95

A Tests all receiving tubes (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. **CRA Adapter $4.50.**

B Entirely electronic sweep circuit with accurately-biased increductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum and leakage eliminated. 5 fund. sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 xtal marker osc., xtal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

C 150 kc to 435 mc with ONE generator in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

D Uni-Probe — exclusive with EICO — only 1 probe performs all functions: half-turn of probe tip selects DC or AC-Ohms. Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.

E Features DC amplifiers! Flat from DC to 4.5 mc, usable to 10 mc. Vert. Sens.: 25 mv/in.; input Z 3 megs; direct-coupled & push-pull throughout. 4-step freq.-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps — 100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync. lim. & ampl. Direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen with dimmer control; plus many more outstanding features.

FREE CATALOG shows you HOW TO SAVE 50% on 65 models of top quality professional test equipment. MAIL COUPON NOW!

New Transistor Portable Radio RA-6
Kit $29.95
Wired $49.95
Incl. F.E.T.; less 9V batt. Prealigned RF, IF xfmrs; push-pull audio; 6" spkr.

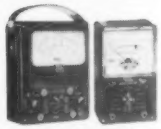
NEW Power & Bias Supply for Transistorized Eqpt. #1020
Kit $19.95
Wired $27.95

NEW Tube & CRT Fil. Tester #612
Kit $3.95
Wired $5.95
Fast-checks radio/TV tubes, pilot lamps, etc.

Series/Parallel **R-C Combination Box #1140**
Kit $13.95
Wired $19.95

Tube Tester #625
Kit $34.95
Wired $49.95
• tests 600 mil series string type tubes
• illuminated roll-chart
Pix Tube Test Adapter..... $4.50

6V & 12V Battery Eliminator & Charger #1050
Kit $29.95
Wired $38.95
Extra-filtered for transistor equipt. **#1060 Kit $38.95 Wired $47.95**



20,000 Ohms/Volt V-O-M #565
Kit $24.95
Wired $29.95
1000 Ohms/Volt V-O-M #536
Kit $12.90
Wired $14.90

EICO®
33-00 Northern Blvd. L.I.C. 1. N.Y.
Add 5% in the West. © 1959
TURN PAGE FOR MORE EICO VALUES

R-C Bridge & R-C-L Comparator #950B
Kit $19.95
Wired $29.95
Reads 0.5 ohms-500 megs, 10 mmfd-5000 mfd, power factor

VTVM Probes

	Kit	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
Scope Probes		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

EICO C-10
33-00 Northern Blvd.
L.I.C. 1, N.Y.

Show me HOW TO SAVE 50% on ☐ Test Instruments ☐ Hi-Fi ☐ Ham Gear. ☐ Send free Stereo Hi-Fi Guide. Send me FREE Catalog, name of neighborhood dealer.

Name.....

Address.....

City.....Zone.....State.....

Radio-Electronics
Hugo Gernsback, Editor

FUTURE AUDIO GOALS

. . . The Great Audio Inventions Are Still to Come . . .

THE birth of audio undoubtedly dates back to the invention of the Bell telephone in 1876. Electronic sound has come a long way during these 83 years, yet the most important audio progress still lies in the future.

We have pointed out repeatedly on this page that recording sound (and video) by mechanical means is but a stopgap;* it is certain not to prevail in the future. Registering sound on record and tape will be considered a crudity in the future—it will give way to pure electronic, nonmechanical recording in which nothing moves except electrons. Such a method would not be noisy, would require no stylus, give no extraneous track sounds. It will store the audio impulses just as a capacitor or an electret stores electricity. The electronic recorder will store the impulses for years, to play them back at will hundreds of times as wanted.

We need not overstress the obvious fact that such sophisticated recording of the future will vastly improve audio and stereo quality. We can also foresee that the physical size and weight of our future sound "records" will be but a small fraction of our present ones. And the price should be lower, too.

One of the most urgently pressing inventions doubtless is *inaudible sound.* Today families are disrupted, neighbors disturbed and estranged by our audio buffs and enthusiasts, as well as over the more common raucous television receiver. Hardly a day passes that the press does not report some unpleasantness on account of excessive sound in somebody's home. Nonmusical and sound-hypersensitive wives, older people, the sick, invalids and others are constantly up in arms over excessive sound sessions that often run into long hours. The esthetics of music when it explodes into high decibels can indeed wreak havoc.

Such a state of affairs is unnecessary, nor will it be tolerated, in the near future. In the electronic age, audio enthusiasts no longer need make enemies or create annoyance to others. Here is one solution—there are a number of other and perhaps better ones.

Let us call the future development *ultra-music.* It uses ultrasonic sound, whose lowest frequency is over 20,000 cycles per second. Humans cannot hear it at all, but canaries and other birds, as well as certain mammals, can hear it readily.

What is required is a simple *electronic ultrasonic converter,* smaller than a thimble.† It will be fully transistorized and easily fits in one's ear. It will not be a difficult electronic engineering task to devise an ultrasonic transmitter that attaches directly to the audio output of a radio, TV, high-fidelity or stereo set. The transmitter can be concealed near the ceiling so that the ultrasonic waves will not be interfered with by furniture, moving human heads, etc. Thus the music will permeate the entire room, *but no one will hear a sound* unless he wears the thimble-sized converter.

Stereo? Just wear *two* converters, one in each ear (and of course have stereo transmitters). Yes, total audio peace *is* possible.

High-fidelity for whom? We hear sounds best between 1,000 and 4,000 vibrations a second.‡ Unfortunately, human hearing deteriorates steadily after age 25. Above this age, persons no longer can hear the true higher sounds of any instrument. Thus a young boy, under the best conditions and with perfect hearing, may hear sounds of from 20 to 30,000** vibrations (cycles) a second; but by the time he is 50, he may hear up to only 10,000 cycles, thus missing practically all the higher overtones of the musical instruments. Cats and other animals, for example, hear sounds very much higher in pitch.

By the time humans get to an age when they are most keen to listen to the world's best musical recording or to live music, nature has stepped in and robbed them of nearly half the sound range by impairing their hearing sense. Of course, they still hear the fundamental tones, but not the higher harmonics. Thus they hear "flat," not brilliant music.

Curiously—and fortunately for humans—we can still enjoy music that we cannot hear with our ears, even if both of our auditory nerves have been destroyed and we are stone deaf. How is this possible? Beethoven was deaf for many years before he died. *This did not prevent him from composing the beautiful music he never heard himself.*

We humans can *think music;* we can carry a tune in our head that is never audible, not even to ourselves. We never have any difficulty reaching very high notes in our mind *as long as we remember such notes from the time when we could still hear.*

How do we hear? Audible sounds are conducted via the ear canal through a complex mechanism involving three bones in the middle ear, the ear drum, and a liquid that fills the inner ear. The ear's diaphragm connects with the auditory nerves which are stimulated by the fibers of Corti. The resulting sensations are then communicated to the brain in a complex and not-too-well understood manner.

For many decades, physicist–scientists have tried to reach certain brain centers of humans who were either blind or deaf and bring light or sound to their consciousness. In this they have partly succeeded: when certain parts of their brains—the visual centers—were touched with probes carrying weak electric currents, flashes of light were distinctly "seen" by blind people. Similar probing of the auditory center of the brain, brought (confused) "sound" to the consciousness of deaf people. Neither experiments brought about true seeing or hearing; they produced only a *simulation* of these senses. But it was a beginning.

We can imagine a future means of bringing actual sound to the consciousness, not only of the totally deaf, but of those who cannot hear the higher register of sound, due to age or partial progressive deafness. We may call it *molecular bioacoustics.*

We can imagine an electronic molecular microwave generator, which gives out subatomic vibrations. When such a generator is connected to a standard high-fidelity or other electronic music source, molecular vibrations are set up in the room. These vibrations are not audible, but convey full and true sounds to the consciousness *by oscillating the hearing centers of the brain.*

By this method, the full range of music from 20 to 30,000 vibrations (cycles) can be heard, no matter what the age or state of hearing of the individual.

NOTE: The suggestions and ideas in this article are from the author's forthcoming book *Ultimate World.*—H.G.

*See "Stored Television Reception," RADIO-ELECTRONICS, January, 1959.
†Such a device has already been patented by Dr. Harry F. Olson of RCA (Pat. No. 2,461,344).
‡Encyclopaedia Britannica
**Encyclopaedia Britannica

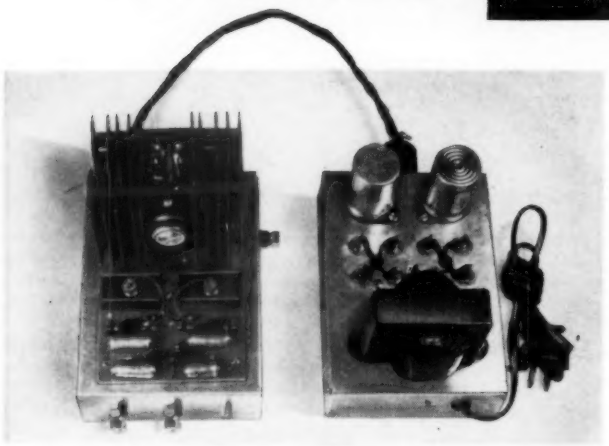
COVER FEATURE

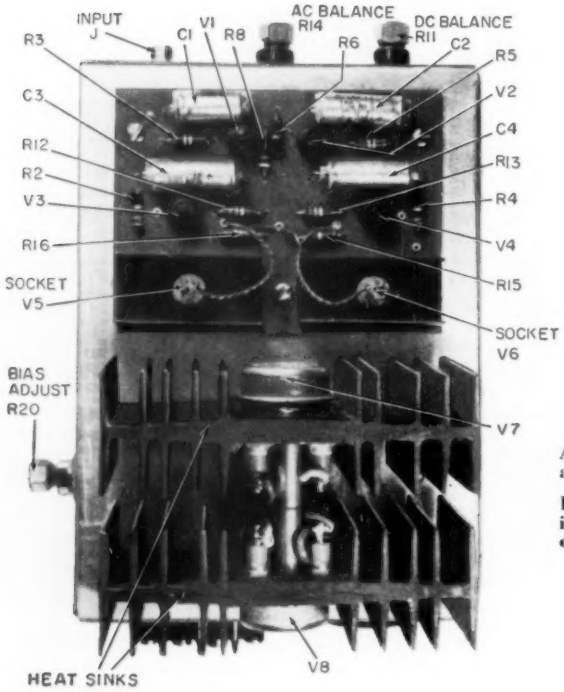
TRANSISTOR OTL* DELIVERS 8 WATTS

* Output TransformerLess amplifier

All-transistor amplifier makes a high-fidelity second-channel amplifier for your stereo system

By DANIEL MEYER*





Above, the amplifier and power supply.

Left, top view, showing placement of parts.

The equipment matches or exceeds the author's claims and his frequency response and harmonic distortion curves are entirely accurate. Intermodulation tests showed no significant IM distortion over the usable range. Square-wave tests showed no appreciable distortion of square waves from 20 cycles to 6,500 cycles. From 6,500 cycles to 10,000 cycles only the higher harmonics were attenuated.

The amplifier has sufficient gain to be driven to a full 8 watts with the output of a 300-mv ceramic phono cartridge. Hum and noise level are down more than 48 db at 8 watts.

THIS amplifier was designed for the second channel of a stereo high-fidelity system. Transistors are not as yet common in such applications, but they have advantages over vacuum tubes in power amplifier use, just as they do in preamps. They generate much less heat and are quieter than vacuum tubes. Distortion and frequency-response characteristics can be made comparible to vaccum-tube amplifiers if the power requirements are not too high. In view of its intended use, the following requirements were decided upon as the minimum acceptable characteristics for the amplifier:

- At least 8 watts output.
- Harmonic distortion below 2%.
- Response flat within ±0.5 db from 20 to 20,000 cycles.

As in vacuum-tube amplifiers, class-A operation is necessary if distortion is to be as low as possible. Several types of distortion are unique to class-B transistor amplifiers.[1] Possibly the hardest to correct is the variation in current-gain factor (beta) over the range of applied signal swing. This variation can differ from one transistor to the next, as can the value of beta at any given amount of collector current. This means matched transistors must be used to get a reasonable distortion level from a class-B amplifier. Even if this is done, there is no guarantee that the transistors will stay matched. (A 30% change in current gain in the first 1,000 hours of operation is not unusual.) In view of this, and since the higher efficiency possible with class-B operation is not an important factor in most high-fidelity applications, this amplifier was designed to use class-A circuitry throughout. It is still considerably more efficient than a vacuum-tube amplifier, since no filament supply is needed.

The circuit

The first thing to be considered was

*Research engineer, Southwest Research Institute.

[1]Jones and Hilbourne, *Transistor A. F. Amplifiers*, Philosophical Library, Inc.

the output stage. Several available output transformers will give 8 to 10 watts output, but they are not high-fidelity type units. This meant that either a transformer would have to be designed and wound or an OTL design used. Transformerless operation eliminates a possible source of distortion, and also reduces the weight and cost. With transistors, this type of operation is especially attractive since a match to standard 4-, 8- or 16-ohm speakers is possible.

Investigation into OTL designs showed that some were undesirable. About the most attractive possibility has complementary transistors in the output stage. This was ruled out because there are no complementary power transistors available that will handle the desired output power. The amplifier must be compatible with presently available speakers, so circuits calling for a center-tapped speaker could not be used. Designs using capacitor coupling to the voice coil were also ruled out. An unreasonably large capacitor would be needed if an amplifier of this power rating were to be flat down to 20 cycles. All things considered, a bridge type output circuit seems to be the most desirable for an amplifier of this sort.

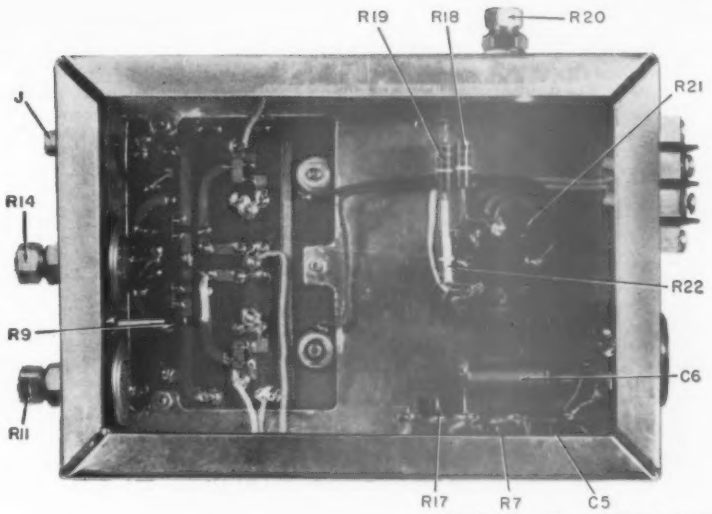
Fig. 1 shows the basic bridge arrangement. The bridge is balanced when the direct-voltage drops across circuit elements 1, 2, 3 and 4 are such that the dc potential across the speaker terminals C–D is zero, regardless of the dc potential across points A and B. In practice, the four elements may be transistors, batteries or other elements. An impedance change in one or more of them will make current flow in the speaker. Transistors may be used to effect such changes and deliver power to the speaker. Since no dc flows in the speaker, and a center tap is not required, conventional speakers can be used.

The amplifier's output stage is much like the bridge circuit used in the output stages of the power amplifiers formerly manufactured by Electro-Voice.[2] A simplified diagram of the output stage of this amplifier is shown in Fig. 2. For either transistor, half the load impedance is in the collector circuit and half in the emitter circuit. However, the collector load for one is the emitter load for the other. This type of operation provides a low output impedance and a large amount of degenerative feedback. The output signal is independent of power supply ripple to the extent that load-voltage excursions remain below the minimum instantaneous supply voltage. The peak-to-peak output voltage across the load can approach BATT1 plus BATT2. The maximum voltage across either transistor is, however, only half this voltage. The amount of zero-signal current in the output stage is determined by the amount of base current in the series combination of the base–emitter resistance of the transistor (V7 or V8), and the resistor from emitter to ground (R7 or R8 in Fig. 2). Since the resistors from emitter to ground are by far the larger of the two resistances, the output is supplied with an essentially constant current bias. This, plus the thermistor in the emitter circuits of V3 and V4, prevents a thermal-runaway condition from developing in the output stage under high ambient temperature.

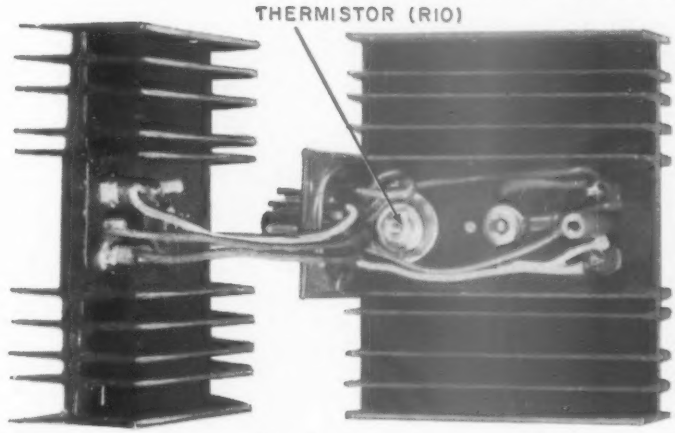
The voltage-amplifying portion of this amplifier (see Fig. 3) consists of a phase inverter, two push-pull voltage amplifiers and two emitter followers. The phase inverter is a transistor version of the long-tailed-pair phase inverter used in vacuum-tube circuits. It provides a reasonably high input impedance for the amplifier because of the large resistance common to the emitters of the first two transistors.

The push-pull signal from the phase inverter is coupled to the two push-pull voltage amplifiers. The voltage amplifiers are needed to get the voltage to

[2]Tomcik and Wiggins, "New Amplifier Has Bridge Circuit Output," *Audio*, November, 1954.



Under the chassis. Printed circuit board makes it neat and uncluttered.



Detail of output transistor plug-in unit. Disassembled, the position of the Thermistor is revealed.

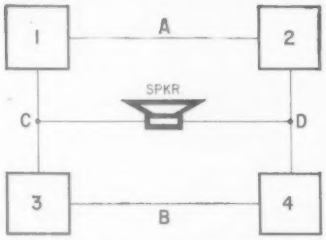


Fig. 1—Basic arrangement of the bridge output circuit.

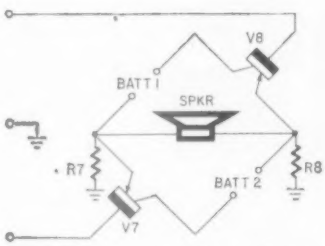
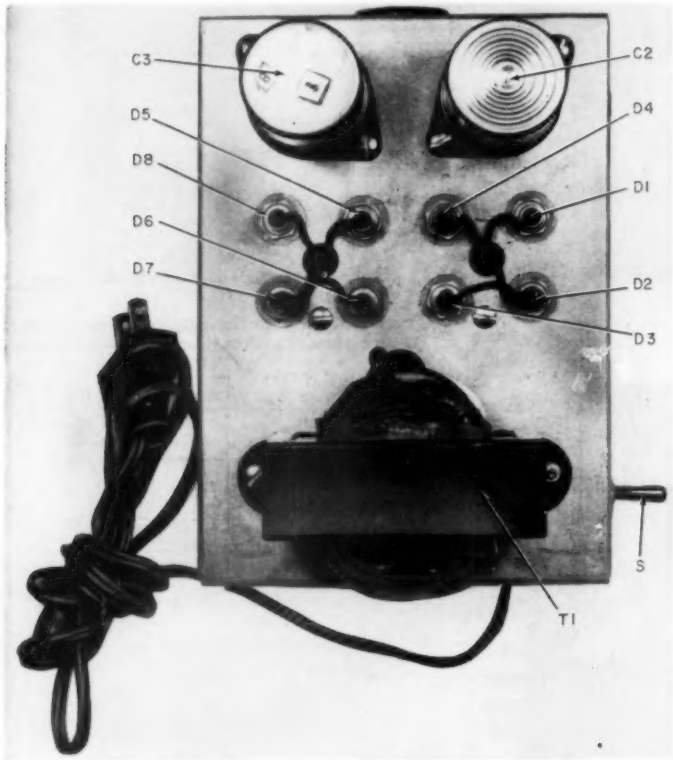


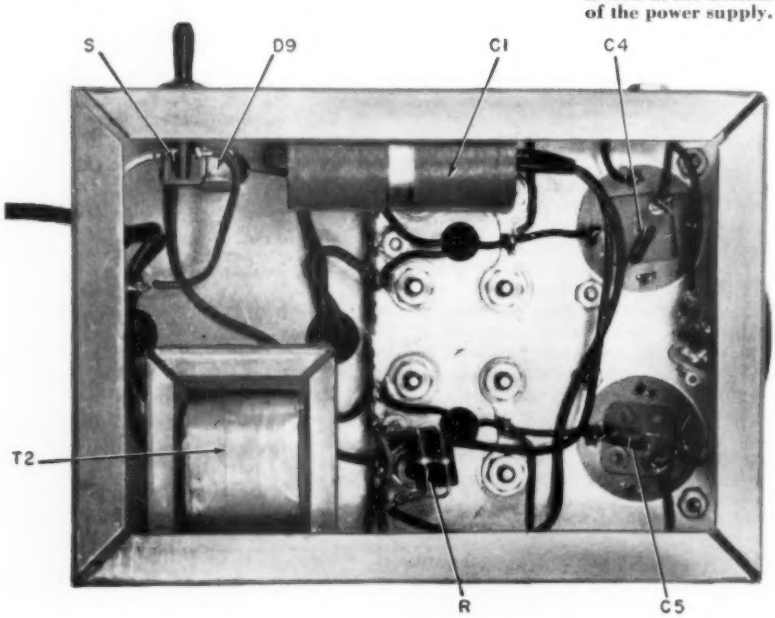
Fig. 2 — Output circuit used in the amplifier.

drive the output transistors. Each output transistor needs a peak-to-peak driving voltage equal to half the desired peak-to-peak output in the load.

The voltage amplifiers are direct-coupled to the two emitter followers, which in turn are direct-coupled to the output transistors. This provides a low-impedance constant-voltage driving source for the output stage. It is the most desirable type source for low distortion, because the input-voltage vs output-current transfer characteristics of power transistors are more linear than the input-current vs output-current characteristics, for the mode of operation used here.



Top view of the power supply. Diode rectifiers are stud-mounted units.



A look at the bottom of the power supply.

Construction

Parts layout is not critical. The pattern for the printed-circuit board used in the voltage amplifier section is shown for those who like to use this type of construction (see Fig. 4). If you use the printed-circuit board, it should be completely assembled before mounting on the chassis. Mount the board with fiber washers between it and the metal chassis. This prevents the creation of any accidental ground loops. The circuit should be grounded to the chassis only at the input jack.

The two output transistors and their heat sinks were made a plug-in unit in the original amplifier. This is easily done by bolting the two heat sinks together and mounting an octal plug on the bottom. The heat sinks used in the original amplifier are available from most Delco distributors as part No. 1221119. The small heat sinks on the emitter-follower transistors (V5 and V6) are 1¾-inch square pieces of 1/16-inch thick aluminum. These pieces are simply bent into a U around the transistors. **Do not skimp on any of the heat sinks.** Skimping can result in a runaway condition at high ambient temperatures.

The thermistor is bolted to the inside of one of the output transistor heat sinks. Insulate the thermistor washer from the bolt and the heat sink with mica washers. The thermistor specified is a washer type and has no leads. Contact should be made to each side with solder lugs cut to fit the washer. These can be made of shim brass or thin copper sheet.

The original amplifier used 2N107's for V1, V2, V3 and V4. But these were selected units, and not all transistors of this type would work well in the circuit. The 2N241's specified in the parts list are recommended. There are no direct replacements for V5 and V6. Do not attempt to use a different type transistor here.

The output transistors were chosen for their flat current-gain characteristics over the range of 0 to 2 amperes. Almost any of the large family of Delco power transistors available in the same style case could be used. I used 2N441's and 2N442's in my unit. However, these are not readily available. They can be replaced with the Delco DS-501, stocked by the Electronics Division of United Motors or Delco distributors. This is a higher-gain version of the 2N441 and 2N442. Be sure and use the mica insulating washer supplied with the transistors to insulate their cases from the heat sinks.

The power supply is the best that could be made with available transformers (see Fig. 5). If it were possible to buy a transformer that would allow full-wave rectification, instead of the two full-wave bridges used here, the number of rectifiers needed could be

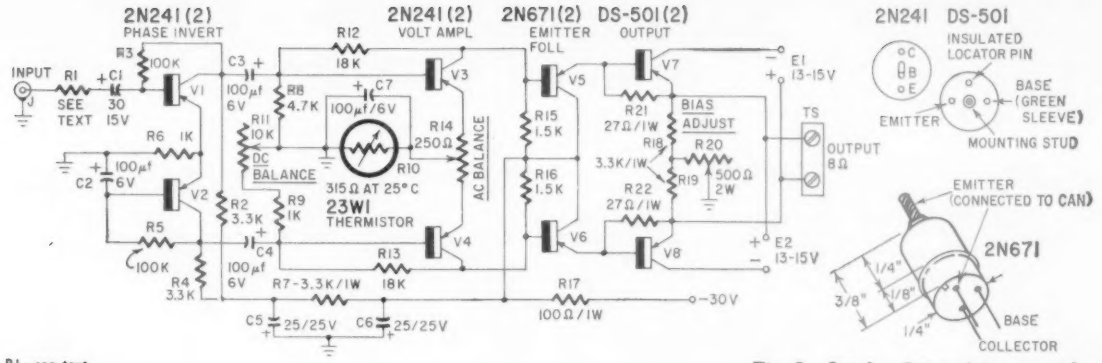


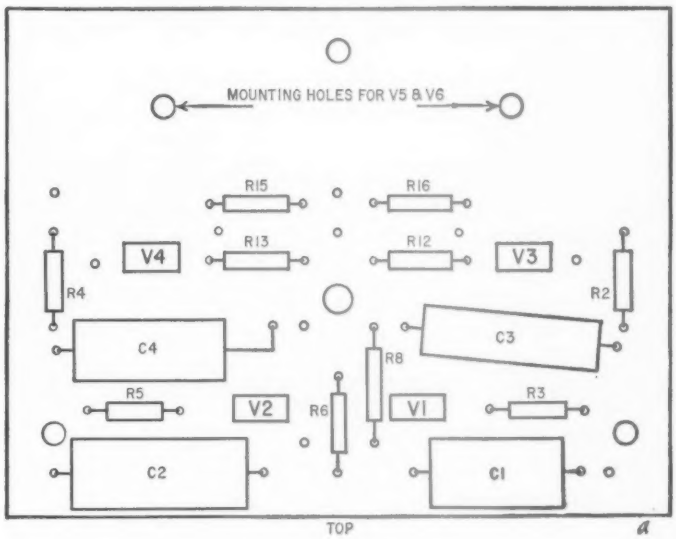
Fig. 3—It takes 8 transistors to make this quality audio amplifier.

R1—see text
R2, 4—3,300 ohms
R3, 5—100,000 ohms
R6, 9—1,000 ohms
R7—3,300 ohms, 1 watt
R8—4,700 ohms
R10—thermistor, 315 ohms @ 25°C, VECO type 23WI or equivalent
R11—pot, 10,000 ohms, linear taper
R12, 13—18,000 ohms
R14—pot, 250 ohms, linear taper
R15, 16—1,500 ohms
R17—100 ohms, 1 watt
R18, 19—3,300 ohms, 1 watt
R20—pot, 500 ohms, linear taper
R21, 22—27 ohms, 1 watt
All resistors ½-watt 10% unless noted
C1—30 µf, 15 volts, electrolytic
C2, 3, 4, 7—100 µf, 6 volts, electrolytic
C5, 6—25 µf, 25 volts, electrolytic
J—phono jack
TS—2-terminal barrier type terminal strip
V1, 2, 3, 4—2N241
V5, 6—2N671
V7, 8—DS-501
Octal sockets (2)
Octal plugs (2)
Chassis—to suit
Miscellaneous hardware
Heat sinks for V5 and V6 (see text)
Heat sinks for V7 and V8 (Delco 1221119 heat radiator package or equivalent) (Available from United Motors, Delco distributors or Delco Radio Div., General Motors Corp., Kokomo, Ind.)

cut in half. The transformer that supplies the —30 volts to operate the voltage-amplifying stages is a rewound Stancor PS-8416. The filament and high-voltage windings were removed, and 500 turns of No. 34 magnet wire wound on top of the original primary. If you would like to wind one transformer for all the needed supplies, the necessary secondary voltages are: two 32-volt ct at 1 amp, and one 50-volt 75-ma. Such a transformer would make a much neater and simpler power supply than the one shown. The rectifier for the —30-volt supply is mounted with a capacitor clip in the original unit. The rectifiers in the two bridges were mounted on the chassis. The instructions for mounting given with these rectifiers should be followed.

Adjust before using

Turn the bias adjustment control to its maximum-resistance position, and center the ac and dc balance controls. With the amplifier turned on, adjust the dc balance control for zero voltage—measured from V3's collector to that of V5. Do this with a dc meter set on its lowest range. Bias control R20 should now be set to give an 800-ma zero-signal current in the output transistors. This measurement can be made by temporarily putting an ammeter in series with one of the output stage power supplies (E1 or E2). A switch type jack for this purpose may be in-



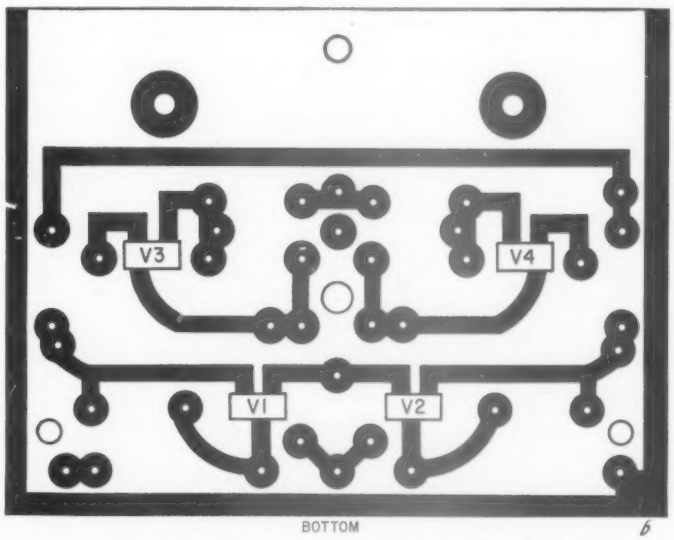
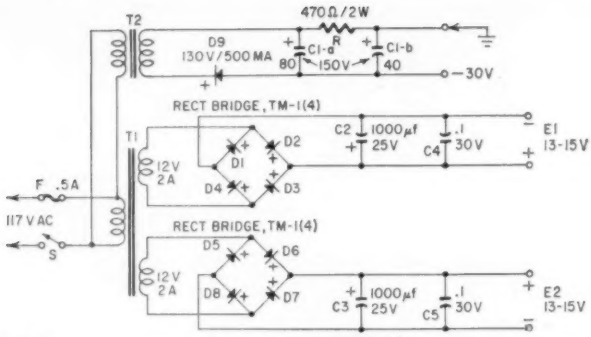


Fig. 4—Actual-size printed-circuit board for the voltage amplifier section of the unit. Of course, point-to-point wiring can also be used.



R—470 ohms, 2 watts
C1—80-40 μf, 150 volts
C2, 3—1,000 μf, 25 volts, electrolytic
C4, 5—0.1 μf, 30 volts, ceramic
D1, 2, 3, 4, 5, 6, 7, 8—1 amp, 50 volts (Transitron TM-1, GE IN1115, International Rectifier 3ATI)
D9—silicon rectifier, 500 ma, 130 volts
F—0.5 amp
S—spst toggle
T1—power transformer: primary, 117 volts; secondary 12 volts, 2 amps; 12 volts, 2 amps (UTC FT-10 or equivalent)
T2—power transformer rewound as per text (Stancor PS-8416)
Chassis—to suit
Miscellaneous hardware

Fig. 5—Two-transformer 9-diode supply delivers operating power to the amplifier.

cluded in the power supply if desired. The adjustment should be checked after about ½ hour of operation and reset if necessary. Adjust the ac balance control for a null at the junction of resistors R18, R19 and R20. This may be measured with either an ac voltmeter or an oscilloscope while feeding a signal into the amplifier with an audio oscillator. Check the dc balance again after adjusting the ac balance. The two controls interact to some extent. This completes the adjustment procedure and the amplifier is ready for use or testing.

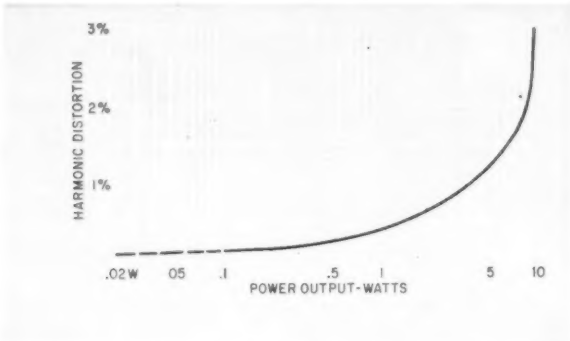


Fig. 6—Harmonic distortion vs. power output measured at 1,000 cycles.

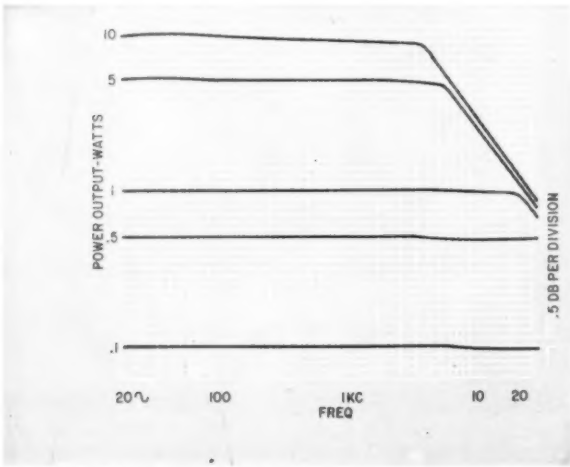


Fig. 7—Curves showing relation between power output and frequency.

Test results

The distortion vs output-power curve shown in Fig. 6 was plotted with a Hewlett Packard model 201B audio oscillator and a Donner model 21 wave analyzer. The frequency-response curves in Fig. 7 were plotted with a Mosley X-Y recorder and a Hewlett Packard model 207A sweep type audio oscillator. All tests were made with an 8-ohm resistive load on the output. OTL operation makes it necessary to design for a specific value of output load. This amplifier was designed to work into an 8-ohm load. A different voice-coil impedance will result in less available output power. It would be necessary to redesign the output stage to get full output with other than an 8-ohm load.

Resistor R1 is put in the input of the first stage to provide it with a current source. This resistor should be about 4,700 ohms. With this value of resistance, the original amplifier had a sensitivity of 0.4 volt for full output. Slight changes in the value of this resistance to adjust the sensitivity of the amplifier are OK. A pot is used as an input level control on a later version.

When working with this amplifier, do not short the case of V5, V6, V7 or V8 to any other part of the amplifier while it is on. The cases are internally connected to the elements inside the transistors, and shorting them could seriously damage the transistors.

Neither side of the output on this amplifier should be grounded. Its output is balanced to ground and half of the output signal appears between each side of the output and ground.

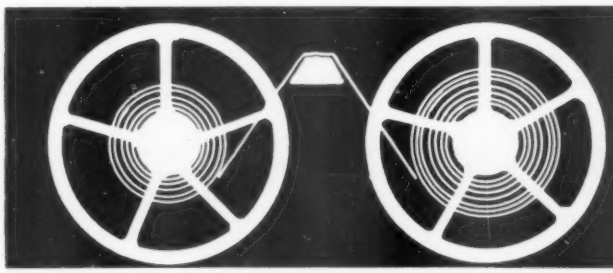
You will note that Fig. 7 shows a reduction in output power at higher frequencies. This is due to the low beta cutoff frequency of the power transistors. Actual performance of the amplifier on program material does not suffer since the power level in music and speech tends to decrease as frequency increases.

Warning: do not test this amplifier for maximum power output at higher frequencies for any great length of time. The drop in beta in the power transistors is accompanied by a phase shift and a reduction in transistor efficiency. Prolonged testing at high frequencies can cause a rapid rise in junction temperature and possibly ruin the transistor. If such tests are made, an ammeter should be used in series with the output transistor power supply. The meter will give a quick visual indication if a runaway condition develops.

The amplifier meets or exceeds the requirements set for it. A listening test will verify this. The low distortion level and almost complete absence of any hum will make this amplifier a pleasure to hear.

The author wishes to thank John M. Prucha of Southwest Research Institute for his many valuable suggestions on the design of this amplifier, and also Southwest Research Institute, whose instruments were used in testing the completed amplifier. END

Stereo on tape is not new, but the machines used to record and reproduce stereo sound are



TAPE MACHINES for STEREO

By CHARLES B. GRAHAM

A FEW years ago it was difficult to find a tape recorder that could be easily connected into a hi-fi system. Either it didn't have an output jack or the one it had wasn't connected to the output of a cathode follower so the connecting cable had to be kept short. Usually the output stage had little feedback and a miniature transformer to get the most sound, however distorted it might be, from the playback.

Today, all that has changed. Almost every recorder we looked at had been engineered with the hi-fi enthusiast—the lover of the recorded sound—in mind.

Looking over the recorders available today, we found a strong trend in home and semiprofessional machines toward units that play back *and record* both two- and four-track stereo and mono tapes. Of the over 35 widely sold tape recorders which play stereo tapes, at least 20 can also record in stereo. And most of these can record *either two or four* tracks.

To assist the prospective purchaser, RADIO-ELECTRONICS contacted every known manufacturer of tape recorders. We compiled a chart that shows many of the facilities of machines now on the market. The chart is divided into two major sections, the first dealing with over 25 of the most popular tape recorders, most priced below $500. The second section deals with machines costing between $500 and $1,000. Recorders selling for more than $1,000 are for professional use only, and run as high as $5,000.

Recorders which cannot play stereo tapes (with the exception of a few high-quality miniature-portable units) are excluded because there are so many such machines. The miniature recorders listed represent another new trend, with their surprisingly good recording characteristics despite their extreme portability.

A few of the least expensive record–playback tape units, along with some intended primarily for dictation, remote-broadcast (spring-wound) pickup and other special purposes are also excluded.

There is a growing number of tape *decks* with heads set up for both two and four tracks. A tape deck is the easy way to add tape to an existing system, since today's stereo preamp–control units and stereo amplifiers all have tape-head inputs and preamplifiers. All the hi-fi man has to do is buy a tape deck for only $100 to $200 and add it to the stereo electronics already on hand, providing stereo tape playback. Later the stereo recording amplifiers can be bought or put together from one of the several kits now on the market.

About the chart

This is not intended as a directory of every model made by every manufacturer of tape recorders. Instead it is a listing of representative machines, describing numerous features and indicating trends. It can be useful to those considering buying a stereo tape recorder, **but should not be the basis for purchasing.** Rather it may serve to indicate whether a particular machine has or does not have certain specific features. After studying the chart, the prospective purchaser can examine the machine(s) he has found most interesting.

Features which all machines have are not included on the chart. For example, all recorders now have a safety interlock arrangement for Record. That is, a separate lever or button must be depressed with one hand *while* the *other* hand turns the selector to Record. The features which are listed are new or vary from one maker to another.

The number of recorders already equipped for four tracks, together with those whose manufacturers will soon join in, along with the long-heralded appearance of four-track tape cartridge-playing machines, indicate that four-track tapes may soon become the standard for all but professional recording. Prerecorded stereo tapes now available include reel-to-reel 7½-ips 2-track, reel-to-reel 7½-ips 4-track, and cartridge loading 3¾-ips 4-track. These last can be played on reel-to-reel 4-track machines by reloading the tape onto 5-inch reels. Most four-track machines not only record stereo both two- and four-track, but can record four individual monophonic tracks as well. This provides such extended recording time on most machines, even with full-thickness 1½-mil tape, that increasing numbers of people are likely to take to using 5-, 4- and even 3-inch tape reels.

Without exception, every stereo tape machine runs at both 7½ and 3¾ ips. In addition, a few include 1⅞ ips, and more will add this speed in the future as head designs continue to improve. Present recording–playback heads with best high-frequency response have a gap width of 90 microns, although the majority of the under-$500 units have heads with 120-micron gaps.

Most machines have cathode-follower outputs (or heavy feedbacks) to facilitate the use of external amplifiers and high-fidelity systems. And all the recorders surveyed were found to have provision for such connection, though the less expensive ones didn't have low-impedance outputs. Instead, they usually came right off the output transformer's secondary, thus keeping the

STEREO TAPE MACHINES

	Model	Playback (Tracks)	Stereo Record (Tracks)	Speed Besides 3¾ & 7½	Hys Sync Motor	Chan 1 Amp	Chan 1 Spkr (in.)	Chan 2 Amp.	Tone Cont.	LO-Z Out	Monitor Head	Record Indicator	Index Counter	2-4-Track Switch	Price (incl. case)†	Case Extra
AMPEX	902	2, 4	—	—	—	PRE	—	PRE	—	2	YES	METER	YES	MECHAN	$449.50	$45
BELL	T-228	2, 4	2	—	—	PRE	—	PRE	—	2	—	EYE	YES	SEP HDS	$329.95	$34.95*
CROWN	GCSP	2[1]	—	15	YES	PRE	—	PRE	—	2	AVAIL	2 METERS	—	—	$595.00	$50–80
HEATH	TR10	2	—	—	—	PRE (KIT)	—	PRE (KIT)	—	2	—	METER	YES	—	$180.50	NO CASE
MAGNECORD	102	2	—	—	—	PRE	—	PRE	—	2	AVAIL	2 METERS	—	SEP HDS	$449.95	$30
NORELCO	CONTINENTAL	2, 4	4	1⅞	—	5 W	5	PRE	1	—	—	METER	YES	NO SWITCH	$288.50	—
	STEREO-400	2, 4	2, 4	1⅞	—	5 W	4 x 6	5 W	1	—	—	EYE	YES	NI	$398.50	—
PENTRON	NL-4	2, 4	2, 4	—	—	P.P. 10 W	4 x 8 (2)	P.P. 10 W	2	—	—	2 EYES	YES	MECHAN	$375.00	—
	XP-605	2, 4	—	—	—	P.P. 10 W	TWO	PRE	1	—	—	EYE	YES	MECHAN	$199.50	—
	TR20	2, 4	—	—	—	10 W	—	10 W	1	—	—	METER	YES	MECHAN	$299.00	—
RECORDIO	592	2	—	—	—	3 W	5 x 7 (2)	3 W	1	—	—	EYE	YES	—	$219.50	—
REVOX	D36ST	2, 4	2	—	YES	6 W	8	6 W	1	2	YES	EYE	YES	SEP HDS	$429.00	—
ROBERTS	90C	2 4	2, 4	—	YES	6 W	5 x 7	PRE	1	2	—	METER	YES	NI	$348.50	—
SONY	DK55A	2	2	—	YES	6 W	—	6 W	1	2	—	2 METERS	YES	—	$485.00	—
TANDBERG	5	2, 4	—	7½	—	3 W	5½ x 8	3 W	—	—	—	EYE	YES	NO SWITCH	$300.50	$22.50
	5-2	2, 4	2 4	7½	—	3 W	5½ x 8	3 W	—	—	—	EYE	YES	NO SWITCH	$469.50	$20.50
TAPESONIC	70CBL	2[1]	—	15	YES	P.P. 10 W	8	—	2	1	YES	METER	YES	—	$446.75	—
TELECTRO	400	2, 4	2, 4	7½	—	8 W	TWO	8 W	1	—	—	2 NEONS	YES	NO SWITCH	$288.95	—
TRUVOX	300-02	2	2	—	—	4 W	6 x 10	4 W	—	2	—	EYE	—	—	$495.00	—
V-M	720	2, 4	2	—	—	8 W	6 x 9, 3.5 (2)	PRE	2	—	—	EYE	YES	—	—	—
WEBCOR	2006	2, 4	—	7½	—	8 W	TWO	8 W	1	—	—	EYE	YES	MECHAN	—	—
	2007	2 4	2, 4	7½	—	8 W	TWO	8 W	2	—	—	METER	YES	MECHAN	—	—
WEBSTER ELEC	350	2, 4	—	—	—	12 W	6 x 9	12 W	1	2	—	METER	—	MECHAN	$455.50*	—
WOLLENSAK	T-1610[2]	—	—	—	—	P.P. 10 W	4 x 6	PRE	—	—	—	EYE	YES	MECHAN	$278.50	—

CARTRIDGE (RCA-TYPE) MACHINES

BELL	402	4	—	3¾ only	—	PRE	—	PRE	—	2	—	—	—	—	$129.95	—
	403	4	4		—	PRE	—	PRE	—	2	—	2 METERS	—	—	$199.95	—
	404	4	4		—	7 W	—	7 W	—	2	—	2 METERS	—	—	$229.95	—
RCA	SCP-2[4]	4	4		—	4 W	6½ 3½ (2)	4 W	2	—	—	2 NEONS	—	—	$298.95*	—
ROBERTS	ADAPTER[5]	4	—		—	(See Mdl. 90C)	—	—	—	—	—	METER	—	—	$75.00	—

HIGHER-PRICED MACHINES

AMPEX	952	2, 4	2	—	—	PRE	—	PRE	—	2	YES	METER	YES	MECHAN	$595.00	$65
	676	2	2	7½ or 3¾	YES	PRE	—	PRE	—	2	—	METER	YES	—	$850.00	$45
CONCERTONE	33	2	2	7½; 3¾ or 15	YES	PRE	—	PRE	—	2	YES	METER	—	—	$895.00	$80
	MARK VII[3]	2, 4	2, 4	7½; 3¾ or 15	YES	PRE	—	PRE	—	2	YES	2 METERS	—	SEP HDS	$995.00	$45
CROWN	GC5X-4	4	4	15	YES	PRE	—	PRE	—	2	YES	2 METERS	—	—	$710.00	$50–80
FERROGRAPH	808/2 or /4	2 or 4	2 or 4	7½, 15	YES	PWR AMP	YES	PRE	—	2	YES	METER	YES	—	$595.00	—
MAGNECORD	728-4X	2, 4	2 4	—	YES	PRE	—	PRE	—	2	YES	2 METERS	YES	SEP HDS	$750.00	$50
NEWCOMB	SM310	2, 4	2, 4	—	YES	PRE	—	PRE	—	2	YES	2 METERS	YES	SEP HDS	$595.00	—
SONY	DK55A4	2, 4	2	—	YES	6 W	—	6 W	1	2	—	2 METERS	YES	SEP HDS	$540.00	—

[1]4-track head on special order. [2]Price for carrying case. [3]Foot-control models available. [4]In portable case; other models soon. [5]For Roberts 90-C & similar machines. [6]Remote control $52.50.

†Audiophile prices net, except where followed by asterisk, indicating list price. May vary with time and geographical location. *List price.

TAPE DECKS

Make	Model	Speeds Besides 3¾ & 7½	Hys Sync Motor	Stereo Play Electronics	Stereo Rec/Play Electronics	Price (Deck only)	Price Incl. Rec/Play Elec
ARKAY	MS-5	—	—	KIT	KIT	$129.95	(NOT AVAIL.)
BELL	T-223	—	—	$40(×2)	$60(×2)	$169.95	$269.95
	401	3¾ ONLY	—†	$40(×2)	$60(×2)	$99.95	$199.95
CROWN	ECT	15	YES	$57(×2)	$190(×2)	$270.00	$650.00
HEATH	TRIAQ	—	—	KIT (INCL.)	KIT (INCL.)	$149.95	$149.95
PENTRON	TM4X	—	—	$18(×2)	$100	$109.95	$109.00
ROBERTS	190-D-4	—	YES	—	$119.50	$189.95	—
TELECTRO	000-5	1⅞	—	$27.50(×2)	$65.00(×2)	$120.25	$256.25
TRUVOX	MK IV	—	—	—	$89.50(×2)	$215.00	$414.00
VIKING	85ES	—	—	$29.50(×2)	$77.50(×2)	$147.00	$234.00
	85ESQ	—	—	$29.50(×2)	$119.00(×2)	$172.00	$286.00
WEBSTER ELEC.*	300	—	—	$70.00	$190.00	$124.00	$313.00

*Webster Electric prices are list.
†RCA type cartridge machine.

transformer and power output tube(s) in the circuit. A number of recorders included two power amplifiers for stereo playback.

Without exception, they all have jacks for connecting larger external speakers to replace the necessarily small speakers in the machines.

Accessory speakers

Most manufacturers of home machines offer companion speaker–amplifier units, either with speaker, amplifier and case closely matching those of the recorder, or with larger speakers and case with a 10-watt push-pull amplifier for the second stereo channel. These units run from $60 to $200. Of course, almost any of these companion units may be used with any recorder preamp regardless of make. About the best reason for using both recorder and supplementary amplifier–speaker of the same manufacture is so they'll look alike and will be about equally efficient, an important factor in left-right switching.

Extra features

Every tape recorder we've come across today has both a high-gain microphone input and a medium-gain input for a crystal phonograph or tuner.

With the exception of some machines costing over $400, today's tape recorders use standard phono or phone plugs for all input and output connections. Some of the more expensive models still use broadcast type connectors.

A great many machines, including the less costly ones, have tape-lifting fingers or other means for keeping the tape away from the heads during high-speed forward or rewind. Surprisingly, some of the very finest mechanisms do *not* have this provision. It is advisable when using such a recorder, to slip the tape out of the head assembly and let it run free during high-speed rewind or forward if the whole reel is to be wound.

Many units, including V-M, Pentron and Webcor models, allow automatic cutoff at the end of tape travel. This is done by running the tape against a microswitch in series with the main on–off switch, in such a way that the switch opens when the tape runs out. The V-M 720, for example, even has an ac utility outlet at its rear which is controlled by the auto-trip switch.

Another desirable feature which is beginning to make its appearance is the speaker disabling switch. In the early days, the use of the microphone position automatically cut out the loudspeaker, to prevent acoustic feedback. This was carried even further in recent years, with most tape recorders having the switching so set that any recording position automatically kills the audio. Now a number of makers are giving the recordist the option of leaving the speaker either on or off during recording, to enable him to monitor the program material. This is not *monitoring the recording*, however. Many people have confused these two types of monitoring and may be misled by the word "monitor" on some low- or medium-priced machines. In those cases there is no separate playback head and preamplifier, both of which are required for instantaneous monitoring of the actual recording, *after* it has passed the recording head.

Some medium-price recorders have a magnetic phonograph preamplifier in addition to the tape-head preamp(s). This permits playing LP's directly into the tape recorder, without intervening amplifiers, and can be a very convenient feature in some special situations.

The neon record indicator which was almost universal a few years ago is now almost entirely replaced by the electron-ray "eye" tube, which in most cases is quite satisfactory. And there are now almost as many models using meters for riding gain as those still using the green electron-ray tubes.

A number of machines have automatic rewind and repeat provision. This is operated by affixing a piece of metal foil at one end (or both), of the tape, which closes a pair of contacts placed in the path of tape travel. This actuates a relay inside the recorder, which then reverses the direction of tape travel.

To play four-track tapes instead of two-track, the lower-price machines (and some of the more expensive ones too) have a lever or screw which can be quickly moved to change the number of tracks accommodated. The most expensive machines have separate heads for quarter-track tapes.

Almost every home recorder now has at least one tone control, and many have gone over to full bass and treble controls. And at least one maker, V-M, has left the treble control in the circuit during *record*, to enable extra equalization of the highs in record. This is a welcome feature if not carried too far.

Although the speakers in most recorders continue to be one or two comparatively small ones, they are almost all replaceable with external speakers by simple plug-in to the "External Speaker" closed-circuit jack which disables the internal speaker or speakers. END

MINIATURE RECORDERS
(Not Stereo)

Make	Model	Speed	Record Time (Min.)	Standard Reels	Record Indicator	Built-in Mon. Spkr.	Batts. Recharge	Batt. Life (Hours)	Size (In.)	Weight (Lbs.)	Price
AMPLIFIER CORP. OF AMER.	312-C	3¾	45	YES	METER	NO	YES	40	12 x 5½ x 9	8	$449.00
FI-CORD	2	1⅞, 3¾	15	YES	EYE	YES	YES	3	10 x 5 x 2½	4	$330.00
MOHAWK	500	3¾	22½	SPCL. CART	METER	NO	NO	50	8½ x 4 x 1⅞	3	$359.50
STELLAVOX	SM-4	7½	15	YES	EYE	YES	YES	3	11 x 5 x 2½	4	$399.00
STUZZI (Ercona)	PRO	7½	45	YES	METER	YES	NO	30	11 x 4½ x 8	8	$380.50
TRANSITAPE	I	1⅞, 3¾	22½	YES	NEON	YES	NO	50	9¾ x 6½ x 3	6½	$210.00

[1]At top speed. [2]Without charging.

HI-FI SERVICING NEEDS new methods

First of a series on high-quality audio service, this story tells how to set up a working hi-fi repair shop; the instruments you need and the cost to your customer. The next article gives step-by-step procedures

By FELIX BREMY*

ELECTRONIC servicing is a constantly changing field and, to be successful, the service shop must change with it. We got started in 1946 and fared especially well during the TV boom years from 1948 to about 1952. At first, TV sales were our major income source, but as the market approached saturation more and more sales went to the discount houses so our business concentrated in the servicing end.

In 1952, hi-fi was breaking loose, so we decided to include facilities for hi-fi sales in our plans to reconstruct and modernize that year. This gave us a steadily growing hi-fi component sales business that naturally led to servicing this equipment. This was where the need for new methods arose.

We had been following the methods previously used for radio and TV—check tubes, check voltages, etc. But they proved inadequate for the higher performance standards built into hi-fi equipment. Where the radio or TV owner is easily satisfied if it plays and sounds reasonably good, the hi-fi owner expects, and is entitled to expect, higher performance standards. We were often faced with the dilemma, "Is this the best this amplifier will do?"

We decided there was only one way to solve this problem—get test equipment that would enable us to determine the performance of the equipment exactly. That is now behind us, and is proving very successful. So we want to pass on some of the results of our experience as an aid and encouragement to others who may be facing the same problems.

There are so many performance checks to make on a hi-fi system that it is best to set the whole thing up as a routine procedure and have done with it. The routine can be followed through with each amplifier, preamp, tuner or what-have-you in a minimum of time, without getting into a situation of "chasing yourself in circles" to find an evasive fault.

This approach has so many advantages that we now see it as the only way to handle hi-fi service. In the first place, it is the quickest and most direct way to find the trouble in a system. This alone means the method pays off.

In addition, it builds customer confidence. Evidence of the consumer acceptance the method brings us is seen in the distances some of them come for our service. Of course, this is partly because, where the radio or TV owner merely wants to "get it fixed" the hi-fi owner is much more discriminating; he wants it to "sound better."

One of the things people ask us is whether we can justify the cost of this approach. We can, by scaling our charges to cover it. Our standard shop rate for radio or TV service time is $6 an hour. To cover the increased cost of the hi-fi approach, test instruments, etc., our audio laboratory rate is $10 an hour.

At first sight, this looks like a rather steep increase. But the consumer does not balk at paying it *because the time saved by our better service methods more than compensates for the higher rate so that the overall charge is no more than he would pay elsewhere.*

You and your customer

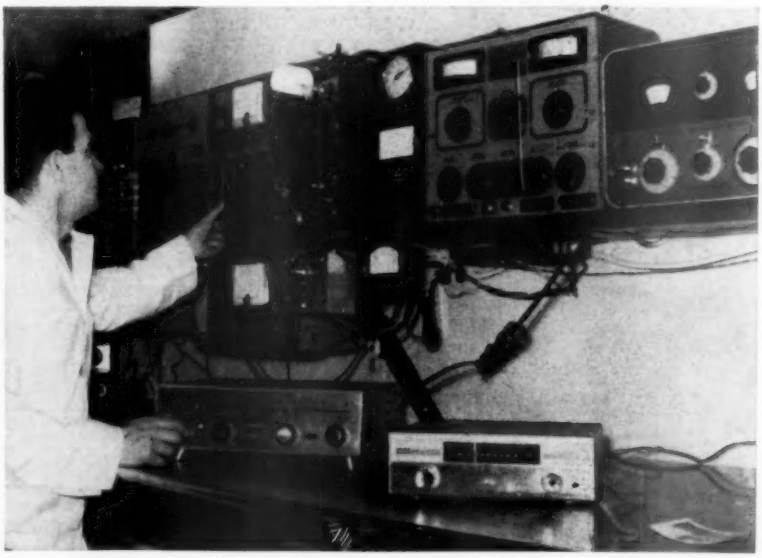
Anyone in the service business for any time must have been at both ends of the "sequence" type case, a set that started with a dried-out electrolytic, replaced by one service shop. Later a different breakdown occurs due to the restored voltage. It is repaired by another service shop. And finally a tube goes bad and is replaced by yet a third shop. To the consumer, the first two were "gyps" and the last an honest guy. With that kind of deal, it's just luck which end you happen to be at. This doesn't happen in audio servicing.

It helps you and boosts customer confidence to use some kind of test report form. It gives you a case history of the equipment for future reference and never fails to impress on the customer that he is getting his money's worth at your establishment. In the latter connection, too, we do not create an air of secrecy with "no admittance" signs, but encourage customers to see our audio test facilities and watch our technicians while they service the equipment.

Another confidence builder is a clean service area. We vacuum frequently and use paint liberally and often. The neat array of instruments and business-like forms we use also helps.

Test instruments you need

But what equipment do you need to get into audio servicing? Fortunately, this is flexible and can be adjusted to anticipated work. We can tell you what



*Owner, Bremy Electronics, 394 E. 18 St., Paterson, N. J.

we have and make some suggestions on variations for different circumstances.

The first necessity for proper audio testing is an audio oscillator or audio signal generator. We chose the Heath AG-8, which proves quite adequate. We preferred the continuously variable frequency feature of this unit to the decade frequency switching of the AG-9, even though the latter's distortion is lower.

The more recent AG-10 is undoubtedly an improved instrument, which we would get if we were starting now. We chose a kit because of the considerable cost saving, as compared with any assembled and calibrated instrument. The kit is adequate for our purposes in both accuracy of calibration and distortion content.

For the output end, an accurate audio voltmeter and some way to measure distortion are musts. We use a Heath AV-3 as a general-purpose audio vtvm, an HD-1 for harmonic-distortion measurements and an AA-1 for intermodulation tests.

If you have more money than time to invest in your instruments, you can buy finished and calibrated instruments for any of these purposes.

A good oscilloscope is another necessity. You need it to look at what you are reading on the instruments. Features that make a scope ideal for audio work are a little different than for radio and TV work but, if you have a good one already, it will probably serve. Ours is a Dumont 224-A, rather dated, but satisfactory.

So we could make really accurate frequency-response tests, we invested in a General Radio 1450-TB decade attenuator, the one with three decade switches, giving control of level measurements to steps of 0.1 db. Extremely accurate, it avoids the little inconsistencies found in less precise instruments for this purpose. Less expensive instruments could be used. Probably for practical purposes they would be accurate enough. But when we started there was a craze to see how flat an amplifier could be made, and the figure of 0.1 db had a magnified importance to many hi-fi people. A two-switch type, giving 1-db steps, really tells you as much as is meaningful in terms of audible performance.

Special equipment

Accurate testing in any of the hi-fi areas (frequency response, power or distortion) is impossible if your line voltage fluctuates as ours does—and we have yet to find a location where it doesn't. To overcome this annoyance we have a Powerstat, made by Supreme Electric Co., in the main feed to the service bench, so fluctuations can be compensated as they occur. Then we use a Weston 744 ac voltmeter as a "standard" to hold it by. We had the meter calibrated around 117 volts by a meter specialist recommended by Weston for our area. Meter plus calibration cost us $44, an extremely worth-while investment.

So much for basic audio testing. Now we come to FM tuners. For general-purpose alignment, or for tuners not among the best, we still use a Hickok model 288X. But for really accurate work we have a Measurements Co. (Boonton, N. J.) model 210A. This is an expenditure you have to be able to justify in terms of FM servicing business. But we have found it worth while. We can now return the best tuners to their owners in top working shape, which previously was impossible. The charge may be a little greater, but the job it does justifies the set owner's original purchase of a more expensive tuner, which run-of-the-mill aligning never could.

Tape recorders need speed checks, so we have a Scott Instrument Labs speed indicator for measuring the actual tape speed past the heads. Flutter and wow, for both tape and disc, are something at present we can only listen for. We would like to be able to measure them quantitatively, but are still searching for the right unit for our purpose.

We measure stylus pressure on the disc with an Arpo pressure gauge, a French-made item obtainable through Geo. Scherr Co., 200 Lafayette St., New York. This is an important thing to be able to measure, and the cost of this item is very reasonable.

Finally, we find it essential to have a complete basic system, stereo, so the component being serviced can be substituted and given a thorough listening test. This is a great way to satisfy the customer too. By using top-grade components in the system, they can also be used for some measurement purposes as well. We use two Dyna Mark III 60-watt power amplifiers with their preamps, using their stereo conversion kit and front plate. We mounted the preamps on a swing bracket to provide ready access to the rear connections.

We use two extended-range 8-inch test speakers right at the test bench for easy recognition of major stereo defects. A selection of larger speaker systems, with 15-inch woofer, mid-range and horn tweeters are located farther back in the room for listening tests.

To complete the picture, a good turntable, arm and stereo cartridge, a high-quality stereo tape deck and a properly aligned FM tuner, provide test bench sound sources. All items used in the system were taken from lines we stock as a dealer. We merely picked components from some of the best lines we carry.

It should be emphasized that all this equipment is used for more than just checking performance *after* servicing. In most instances it is used in the service operation itself. Naturally, when equipment comes in that does not play at all, it is a matter for straight old-

(Left) Taking distortion measurements as a preliminary check on this FM receiver. (Right) Aligning the FM receiver for best hi-fi listening.

fashioned signal-tracing procedure, or voltage checks, to find the failure. But many hi-fi complaints are not a matter of "the unit doesn't work." Rather, the equipment does not perform *as it should.*

These situations are the starting point of many hassels. There are differences of opinion. Does it really play better than it did before? And who can identify just what the defect was anyway?

Typical job

Let's illustrate with an actual case. A customer brings in an amplifier suspected of producing distortion. Using our method, we find power output down and more than the specified distortion. Replacing the output tubes gives a 10% increase in maximum power and a substantial reduction in distortion. The customer is satisfied we found the trouble.

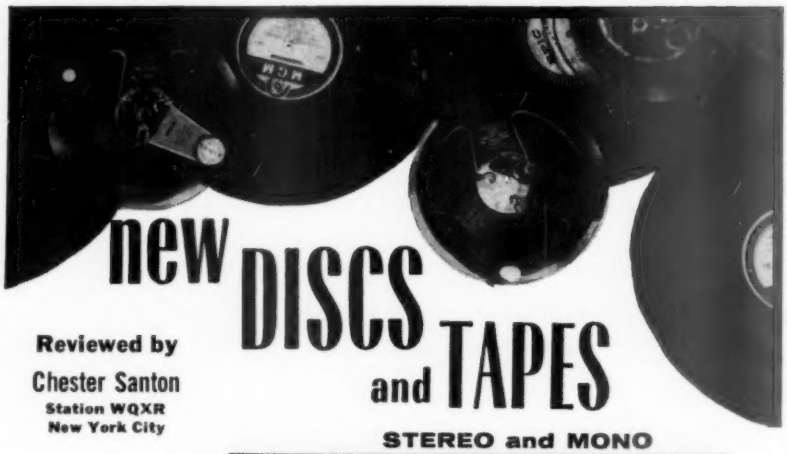
But had we been restricted to the old method, we would have found his tubes still check out "good" even on a first-rate mutual conductance tube tester. If we merely replace the tubes as routine, because of their age, the customer could suspect unnecessary parts replacement. If the tube tester's finding is taken, we could go on a troubleshooting trip that could take a week, and nobody would be happy. But the new performance test method lets us do a quick, reliable service job.

You can work out your own way of making charges to cover your investment. Whichever way you do it, you will find your customer a very different type from your radio–TV service client. A lot has been said on both sides about radio–TV servicing. By honest operation and fair charges, you can stay in business. You will probably get the reputation we have: "not the cheapest place, but reliable." Even so, there will be those sequence cases where you happen to get "the wrong end."

But for the hi-fi customer there is nowhere to go for service—or almost nowhere. He looks down the yellow pages at the "Radio Dealers & Service" listings with little hope of finding someone who can do a thorough job on hi-fi. So what are we all waiting for?

We get plenty of customers besides those who buy hi-fi components from us. Discount stores don't tackle service—not hi-fi, anyway. All the hi-fi owner wants to know is where to take it for service. So it is not surprising, as we found, that a small ad in the local paper regularly brings really good results. All you need is your name, a short message, "All makes of high-fidelity equipment reliably serviced," and your phone number.

New methods have to be learned. Routines for each test can be formalized, so they can be performed in the minimum time, and a test sheet provides an automatic check so your technician can work to a systematic routine. In a second article we will detail the tests and methods used. END



new DISCS and TAPES

Reviewed by
Chester Santon
Station WQXR
New York City

STEREO and MONO

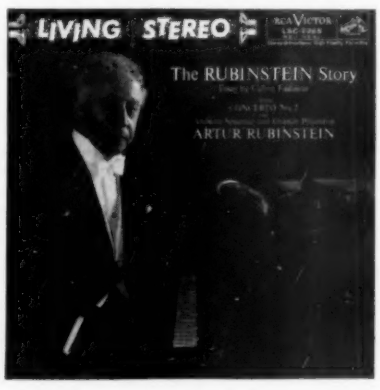
DISCUSSING with audio dealers the demonstration records listed this month, I discovered complete agreement on one point. In New York City, today's demonstration items are regular releases selected with greater ease. Music has completely replaced sound effects for demonstration purposes. Unlike the situation a year ago, a large percentage of stereo discs are now considered worthy of demo use.

Doubling in Brass
Morton Gould and His Symphonic Band
RCA Victor Stereo Record LSC-2308

RCA's stereo discs are now coming through with an added ingredient in the pressing material. The term "miracle surface" on the jacket identifies the new anti-static formula. I've sampled about 15 releases so treated and they do not attract dust in the manner long familiar to LP collectors. The records looked cleaner when first taken out of the unsealed jackets. Subsequent dust does not cling in the way it used to. This particular Morton Gould pressing was unique in one respect. A half-dozen bubbles scattered throughout the disc were plainly audible. Another copy of the same release was as quiet and blemish-free as the rest of the new anti-static items. The improvement in signal-to-noise ratio reveals minute details in Gould's flexible arrangements of *Yankee Doodle, Dixie, American Patrol* and six Sousa marches.

TCHAIKOVSKY: *1812 Overture*
Fritz Reiner conducting Chicago Symphony Orchestra
RCA Victor Stereo Record LSC-2241

As all audiophiles know, this overture has been considered one of the top tests of a mono rig, and most stereo conversions are bound to meet up with the *1812* sooner or later. With this in mind, I decided to compare the early London version (CS-6038 with Kenneth Alwyn and the London Symphony Orchestra), the Mercury disc (Dorati and the Minneapolis, SR-90054) and this stereo reissue by Reiner and the Chicago Symphony. In terms of spacious acoustics and incisive playing, the Victor version has the lead. It is, however, rather cramped for groove space. Unlike the other two versions, it occupies less than one side of a disc. The London and Mercury jobs use closer mike pickups to deliver the rich lows of the bass drum made possible by wider grooves. Instrumental groups are less easy to spot in the Mercury pickup pattern. The problem of reproducing the bells and cannon in the finale is still a tough one. Most of the stereo pickups now in use seem to have too much mass to do justice to very heavy modulation in a stereo groove. I have played these three records with a stereo pickup . . . . mass requires a minimum stylus pressure of 4 grams in order to track properly. Then, using the same tone arm, I repeated the test with a stereo pickup whose mass had been reduced to the point where stylus pressure could not exceed three grams without introducing audible distortion. Each version of the *1812* had cleaner, more transparent sound with the pickup of lower mass.



Music of Lehar and Strauss
Anton Paulik conducting Vienna State Opera Orchestra
Vanguard Stereolab Record SRV 111-SD

The latest $2.98 Stereolab demonstration disc piles up new evidence that this series is one of the best bargains in the business. Unlike the usual stereo discs made to sell for $3, the frequency range includes sweet highs that would do credit to many full-price items on the market today. Very low noise level in the pressing. Lehar and Strauss waltzes predominate in the lineup of light music but galops and polkas get their share of attention in bright-sounding acoustics.

Highland Pageantry
Pipes and Drums and Regimental Band of the Black Watch
RCA Victor Stereo Record LSP-1525

Recorded individually, a group of bagpipes or a military brass band is a challenge to any sound system. Combine the two and you have a heaping measure of test material. Try the beginning of Side A as the bagpipes move forward in the left channel. When they attain full volume, they are joined by the military band which is heard in the right channel. If your stereo pickup can separate the rumpus raised by these two groups, you should find smooth sailing in the days ahead. In addition to parade and ceremonial music of the Black Watch regiment, the record also contains tunes made famous by Sir Harry Lauder.

CHOPIN: *Concerto No. 2 in F Minor*
Andante Spianato and Grande Polonaise
Artur Rubinstein, piano
Alfred Wallenstein conducting Symphony of the Air
RCA Victor Stereo Record LSC-2265

Unlike the Beethoven piano concerto series of a few years ago with boomy sound that drew considerable criticism in audio circles, this release offers the finest sound Rubinstein has enjoyed on stereo discs. Adherence to the RIAA curve retains a smoothness and naturalness in the sound of the piano that is still a rarity these days. Rubinstein, for many years the top-

ranking interpreter of Chopin, takes full advantage of stereo's depth to communicate his understanding of the score.

New Sounds at the Roosevelt
Larry Elgart and His Orchestra
RCA Victor Stereo Record LSP-2045

Here's a stereo setup that places the listener at the edge of the bandstand. The smooth restraint of Larry Elgart's distinctive style is heard to best advantage at a playback level high enough to bring out the rhythm section located in the center of the band. At low level, the saxes on the left and brasses on the right tend to dominate the scene.

PUCCINI: *Turandot*
Alberto Erede conducting Chorus and Orchestra of Accademia Di Santa Cecilia, Rome
London Stereo Records (3) OSA-1308

On discs, the opera *Turandot*, with its exotic setting of China in the days of the emperors, is extremely effective in stereo. The Chinese gongs, bells and wooden blocks have been recorded with fabulous presence. Heard in the foreground, they place the large chorus in deeper-than-average stereo perspective. With ample reserve of power in playback facilities, this recording easily surpasses the mono version of the work as recorded by the same cast.

TCHAIKOVSKY: *Violin Concerto in D Major*
MENDELSSOHN: *Violin Concerto in E Minor*
Isaac Stern, violin
Eugene Ormandy conducting Philadelphia Orchestra
Columbia Stereo Record MS-6062

The latest stereo versions of the Mendelssohn violin concerto offer interesting contrast. A recent RCA disc (LSC-2314) features Heifetz in the same work. Stern's warmer tone is miked at greater distance. On the other hand, the orchestral accompaniment on the Heifetz disc (Boston Symphony under Munch) occupies a wider area between speakers than does the Philadelphia Orchestra. The Tchaikovsky side is a corker, placing Stern at the head of the list in my book.

DVORAK: *Symphony No. 5 in E Minor*
Bruno Walter conducting Columbia Symphony Orchestra
Columbia Stereo Record MS-6066

One month has seen the release by Columbia of two versions of the Dvorak *New World Symphony*. In addition to this item, an Epic stereo disc (BC-1026) carries a new performance by George Szell and the Cleveland Orchestra. The Walter reading, broad and generous in phrasing, has the better sound and surface. The Szell version offers greater separation and a more polished ensemble whose reflexes pattern themselves more closely to the commands of the conductor.

BEETHOVEN: *Symphony No. 9 in D Minor*
Symphony No. 8 in F
Charles Munch conducting Boston Symphony Orchestra
RCA Victor Stereo Records (2) LSC-6066

Those seeking a fuller measure of German seasoning in the performance may have to look elsewhere, but RCA has placed on the market the best-engineered stereo recording of the Beethoven *Ninth* available to date. The tympani in the second movement has the neat tautness of a good mono disc. In the final choral movement, soloists and the New England Conservatory Chorus maintain their identity during the loudest orchestral passages.

RIMSKY-KORSAKOV: *Scheherazade*
Leonard Bernstein conducting New York Philharmonic
Columbia Stereo Record MS-6069

Although this performance does not convey the warmth and poetry of the Beecham stereo version, it leads all stereo releases in the sound department. The Ansermet, Monteux and Rossi records are already dated in audio quality and Columbia has dropped the noise level to a point far below that of the other discs.

BACH: *Brandenburg Concertos*
Charles Munch conducting Boston Symphony Orchestra
RCA Victor Stereo Records (3) LSC-6140

This is the first complete stereo Brandenburg set to occupy six record sides. London manages in five and Columbia in four. It's interesting to note that the mono version of this Tanglewood recording is available on two records. RCA's liberal use of groove space results in an audible difference in sound that will have its greatest effect on people who do not have to buy their own phonograph records. The alert playing of the Boston Symphony's first-desk personnel, heard in natural closeup, is in many ways the best of the current crop. I don't go along with the use of a present-day piano in the *Fifth Concerto*, written to give the harpsichord its first starring role in orchestral chamber music. Room ambience at Tanglewood's Theatre-Concert Hall is ample for the demands of this intimate music.

In this space will appear a report on recordings being used by leading audio dealers across the country when demonstrating the performance of component systems. Unless already covered, most of the discs or tapes selected by the dealer for use in his showroom will be reviewed in future issues.

Among the dealers checked in New York City, Harvey Radio Co. has been playing the Deutsche Grammophon stereo disc (DGS 712013) of Offenbach's *Gaite Parisienne*; Electronic Workshop, the new Columbia stereo disc (CS 8098) *Duke Ellington at the Bal Masque*; Thalia Hi-Fi Audio, the London stereo album of Wagner's opera *Das Rheingold* (OSA 1309). Found effective at Allied Radio in Chicago is Mercury's stereo music of *Leroy Anderson* (SR 90047).

WAGNER: *Das Rheingold*
Georg Solti conducting Soloists and Vienna Philharmonic Orchestra
London Stereo Records (3) OSA-1309

This album sums up the progress made in stereo discs up to the moment this was written. The opera, although a stranger to records, has stage effects whose sounds defy description when recorded in London's latest stereo techniques. Wagner specified 18 anvils beaten approximately in unison, 7 harps and a thunder apparatus as part of the score. Impressive as these are on a big system, the recording of the orchestra is sufficient to make this the outstanding demonstration album of the year. A fine system reveals the soaring highs and rich bass of the best mono discs. Performance is tops. Full stereo spread is combined with a dynamic range that is startling in its impact. Don't miss this one.

SCHUBERT: *"Trout" Quintet*
Fine Arts Quartet with Frank Glazer, piano
Concert-Disc Stereo Record CS-206

The most accessible and tuneful work for piano and string quartet takes on new zest in the grooves of this record. Directionality is natural and easily defined. No other version in the stereo catalog excels this one in sheer cleanness of sound.

Shearing on Stage
George Shearing Quintet
Capitol Stereo Record ST-1187

Claremont College in Southern California is the scene of this first live-performance recording by the Shearing Quintet. It is, without question, their most diverting effort on stereo records to date. The brief introductory remarks by George Shearing are as easy-going as his well-known piano style and establish excellent rapport with each audience. Without recourse to cross-channel antics, Capitol has achieved maximum stage effect with stereo that is completely spontaneous.

NOTE: Records below are 12-inch mono LP and play back with RIAA curve unless otherwise indicated.

FALLA: *Three-Cornered Hat* (Complete Ballet)
Jesus Arambarri conducting Orquesta de Conciertos de Madrid
Columbia ML-5358

Owners of monophonic moving-coil pickups are warned to introduce severe cutoff of highs before playing this one for a neighbor. Even variable-reluctance cartridges with a lot of damping will reveal that this record does not follow the RIAA recording curve. The performance, more authentic in flavor than other recorded versions of the complete ballet, is well worth the extra effort involved in flattening out the curve. Listen for the piccolo in the opening measures of the work. Once those highs have been brought under control, you have the setting for the rest of the record.

For the Very First Time
Glenn Miller and His Orchestra
RCA Victor LPM-6100

The tunes heard in this fancy-package three-record set are taken from off-the-air recordings made while the Miller band was broadcasting a quarter-hour series of CBS shows from 1940 to 1942. The sound quality of the air checks is poor even by standards of that time. To make matters a bit more uncomfortable for the engineers in charge of the dubbing process, the original glass-base acetates were not protected against dust and scratches. Any suggestion of highs as we know them on discs today had to be sacrificed in the transfer to LP. The spirit of the Forties remains very much alive in the sound of its leading band.

Barney Kessel Plays Carmen
Contemporary M 3563

In one of the major surprises of the present jazz scene, Contemporary's star guitarist, Barney Kessel, takes on the best-known tunes of the world's most popular opera. His adaptation of Bizet's *Carmen* has sufficient fire and good humor to start a new trend. Andre Previn, Shelly Manne, Buddy Collette and Victor Feldman are prominent in the supporting cast. Very clean sound.

BEETHOVEN: *Violin Concerto in D Major*
Leonid Kogan, violin
Kiril Kondrashin conducting State Orchestra of USSR
Lion CL-40001

Russian performances imported by MGM Records are now available on their lower-priced Lion label. Kogan is a fine artist so the record represents a good buy for bargain hunters who are willing to put up with record surfaces that are somewhat less than the best.

Speak Low
Maurice Levine and His Orchestra
Warner Bros. B-1313

Updated and generally stylish treatment of a dozen Kurt Weill tunes that cover some of his lesser-shows such as *Firebrand of Florence* and *Love Life*. The theater-size orchestra sounds better with less than usual Warner processing of the signal. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, 154 West 14th St., New York 11, N. Y.

Integrate for STEREO

Why all amps on one chassis may be better

By LARRY STECKLER
ASSOCIATE EDITOR

WHY put all your stereo equipment on one chassis? Because it's cheaper! One integrated amplifier—two preamps, two power amplifiers, one stereo adapter and one power supply all on the same chassis—costs less than the same units on separate chassis, each with its own power supply. But assuming you've already decided you want an integrated amplifier, how do you go about picking the right one for you?

That depends on several things: the equipment you now have, how much you can afford to spend and what you want from your new stereo amplifier. If you now have a monaural system with a 60-watt amplifier and have decided to replace it with an integrated amplifier, you'll want a unit that will deliver at least the same amount of power. So you'll need a unit that has two 30-watt channels at a minimum. You will also want to be sure that the new unit has about the same or better specifications than the units you are now using.

You also have something new to contend with: crosstalk—the amount of interaction between the two channels. The less the better—the larger the separation, the less the interaction.

Also make sure the amplifier has all the inputs you are going to need. In an integrated amplifier, the switching system gets kind of complicated. So the number of inputs is usually smaller than for a comparable monophonic unit. Fig. 1 shows the switching used in the Pilot model 240. It has five pairs of inputs and uses a four-pole five-position switch to select the desired pair. It also has a three-pole four-position switch that is used to select the mode of operation—stereo, stereo reverse, mono channel A and mono channel B.

Another consideration is the type of output stage. Some use a standard push-pull pentode output stage with 35C5's, 35DZ8's, 6AQ5's, 6AV5's, EL-84's, ECL-82's, 6V6's, 50L6's and 6CA7's. Others use the Ultra-Linear output stage with 6CA7's, 6BQ5's and EL-84's. One set, the Masco SA-202, uses a single-ended output for each of the two channels when operating stereo, and switches them to a push-pull output for mono operation. The switching is handled before the first voltage amplifier (Fig. 2).

Some sets are ac–dc and don't have

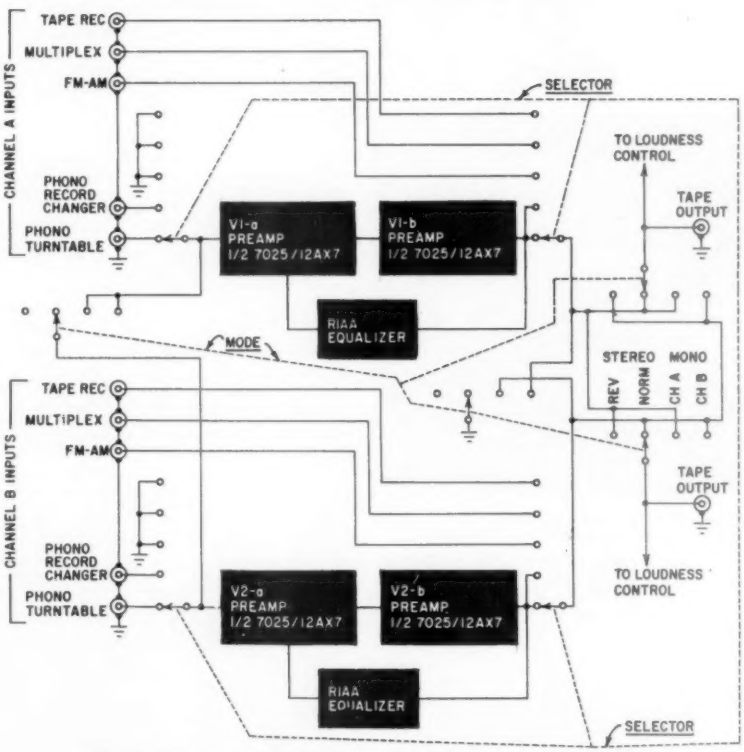


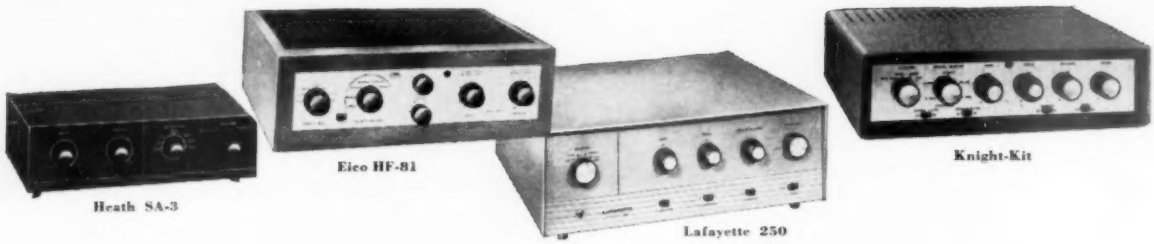
Fig. 1—That stereo switching is complicated, is clearly shown by this partial block diagram of the Pilot model 240.

INTEGRATED STEREO AMPLIFIER SPECIFICATIONS

Manufacturer	Model	Output per Channel (Watts)	Distortion	Sig-to-Noise Low-level input (db down)	Sensitivity Mag Phono (mv in)	Channel Separation (db)	Bass & Treble Controls	Loudness Control (If Any)	Stereo Tape Output	Pairs of Inputs	Approx. Price (Audiophile Net)
ALLIED	KNIGHT KN-520	10	HARMONIC 2%	50	3	45	SEPARATE	NONE	NO	3	$64.50
	KNIGHT KN-740	20	HARMONIC 1%	52	5	50	GANGED	SWITCH IN	YES	5	$99.50
	KNIGHT KN-760	30	HARMONIC 0.75%	52	5	50	SEPARATE	SWITCH IN	YES	5	$149.95
ARKAY	CS-28	14	HARMONIC UNDER 1% IM UNDER 1%	70	3.5	NI	GANGED	SWITCH IN	YES	5	$64.95* $99.95**
	CS-12	6	HARMONIC 0.9% IM 1.2%	60	3M (HI LEVEL)	45	GANGED	SWITCH IN	YES	5	$39.95*
BELL	CARILLON 6060	30	HARMONIC UNDER 1% IM 0.7%	71	5	APPROX. 55	SEPARATE	SEP. CONTROL	YES	7	$219.95
	3030	15	HARMONIC 0.5%	78	3	APPROX. 55	GANGED	SEP. CONTROL	YES	5	$169.95
	PACEMAKER 2221	10	HARMONIC 2%	65	3	APPROX. 55	GANGED	NONE	YES	1+AM, FM	$129.95
	PACEMAKER 2212B	7	UNDER 3% TOTAL	60	350 (HI LEVEL)	APPROX. 55	GANGED	NONE	YES	1+AM, FM	$69.95
BOGEN	AC220	10	HARMONIC UNDER 1%	60	4.5	45	GANGED	SWITCH IN	NO	3	$79.95
	DB230A	30	HARMONIC UNDER 1%	75	4	BETTER THAN 50	SEPARATE	SWITCH IN	YES	5	$189.50
	DB212	12	HARMONIC 1% IM UNDER 2%	55	4	BETTER THAN 50	SEPARATE†	NONE	YES	5	$119.95
DeWALD	CONCERTO N-1200-B	15	IM APPROX. 1%	75	6	BETTER THAN 50	SEPARATE	SEP. CONTROL	YES	5	$98.95
EICO	HF-81** HF-81K*	14	HARMONIC UNDER 1%	60	4	BETTER THAN 40	SEPARATE	NONE	YES	5+AM, FM	$109.95** $89.95*
ERIC	DUAL TEN 2460	8	HARMONIC 1%	65	NI	NI	SEPARATE	COMB. LOUDNESS-VOL.	NO	3	NI
FISHER	X-101A	20	0.7% TOTAL	80	3	50	SEPARATE	SWITCH IN	YES	6	$194.50
GENERAL ELECTRIC	MS-4000	20	UNDER 1%	62	3.5	40	GANGED	SEP. CONTROL	YES	3+MONO PHONO MONO AUX.	$168.55
	MS-2000	14	UNDER 1%	55	3.5	40	GANGED	SEP. CONTROL	YES	3+MONO PHONO MONO AUX.	$127.35
GROMMES	24PG	12	HARMONIC 1% IM 2%	80 (HI LEVEL)	4	NI	GANGED	SWITCH IN	YES	5	$99.95
	40PG	20	HARMONIC 1% IM 2%	80 (HI LEVEL)	4	NI	GANGED	SWITCH IN	YES	5	$177.95
HARMAN-KARDON	LUTE A220	10	HARMONIC UNDER 2%	50	4	BETTER THAN 50	GANGED	COMB. LOUDNESS-VOL.	YES	3	$79.95
	BALLAD A230	15	HARMONIC UNDER 1%	60	3	BETTER THAN 50	CLUTCH GANGED	SWITCH IN	YES	4	$109.95
	CHORALE A260	30	HARMONIC UNDER 0.5%	75	2.5	BETTER THAN 50	CLUTCH‡ GANGED	SWITCH IN	YES	6	$199.95
HEATHKIT	SA-3	3	HARMONIC UNDER 3% IM UNDER 3%	65	150 (HI LEVEL)	BETTER THAN 50	GANGED	NONE	NO	2	$29.95*
KNIGHT-KIT	83 YX 773	10	HARMONIC UNDER 1.5%	57	6	BETTER THAN 45	GANGED	NONE	YES	4	$44.50*
	83 YX 774	20	HARMONIC UNDER 0.5%	60	2.5	BETTER THAN 35	CLUTCH GANGED	SWITCH IN	YES	5	APPROX.* $80.00
LAFAYETTE	KT-250* LA-250**	25	HARMONIC UNDER 0.25% IM UNDER 1%	73	3	BETTER THAN 50	GANGED	SWITCH IN	YES	5	$64.50* $89.50**
	LA-235	17	HARMONIC UNDER 2% IM UNDER 1%	55	4	BETTER THAN 40	CLUTCH GANGED	NONE	YES	5	$69.50
	KT-230* LA-230**	18	HARMONIC UNDER 0.25% IM UNDER 1%	53	3	BETTER THAN 50	CLUTCH GANGED	NONE	YES	4	$52.50* $69.50**
MASCO	SA-200	2	UNDER 2% TOTAL	NI	180 (HI LEVEL)	NI	SEPARATE	NONE	NO	1	$29.95
PACO	SA-40* SA-40W**	20	HARMONIC UNDER 0.2% IM UNDER 1%	70	5	50	GANGED	SWITCH IN	YES	7	$79.95* $129.95**
PILOT	240	15	HARMONIC UNDER 1%	80	3	NI	GANGED OR SEPARATE	SWITCH IN	YES	5	$129.50
	245-A	20	HARMONIC UNDER 1%	80	3	NI	GANGED OR SEPARATE	SWITCH IN	YES	7	$199.50
RADIO SHACK	STEREOLYNE 40	20	HARMONIC 0.9% IM 1.5%	59	3	NI	SEPARATE	SWITCH IN	NO	4	$79.50
	STEREOLYNE 7	1	HARMONIC 3.5%	53	110 (HI LEVEL)	NI	GANGED†	NONE	NO	2	$29.95
SARGENT-RAYMENT	SR-17-17B	20	HARMONIC 0.48% IM UNDER 1.5%	60	3.5	41	GANGED	SEP. CONTROL	YES	6	$189.60
SCOTT, H. H.	221	12	HARMONIC 0.8% IM 0.3%	60	3	50	SEPARATE	SWITCH IN	YES	4	$139.95
	299	20	HARMONIC 0.8% IM 0.3%	60	3	50	SEPARATE	SWITCH IN	YES	5	$199.95
SHERWOOD	S-5000	20	IM 1%	60	1.8	BETTER THAN 50	GANGED	SWITCH IN	YES	5	$189.95
SONIC	S-100	5	HARMONIC UNDER 3%	56	400 (HI LEVEL)	40	SEPARATE†	NONE	NO	2	$34.95
	S-200	6	HARMONIC UNDER 2%	56	400 (HI LEVEL)	45	GANGED	SEP. CONTROL	NO	3	$48.95
	S-400	20	HARMONIC UNDER 1%	58	5	45	GANGED	SEP. CONTROL	NO	4	$98.95

NI—No information available.
*Kit

**Wired.
†Single control for bass and treble.
‡Tone control defeat switch
All specifications supplied in manufacturer's literature.



a power transformer. Instead they use a voltage doubler with selenium or silicon rectifiers. Of course, these units may present a shock hazard, so if you buy one, watch how you connect it to the line. Be sure the chassis is not connected to the hot side of the line. As far as power supplies go, both tubes and semiconductor rectifiers are used.

Some units have dc heaters to reduce noise and hum in the unit. Series-string heaters are used by Arkay in one of their integrated amplifiers. As shown in Fig. 3, two groups of three and a half tubes are placed in parallel across the ac line. It's a money-saving arrangement, but what if one half of V1 opens? This would be a toughie to find. For example, assume the lower half is open. V6, V7 and V5 would, of course, go out, but half of V1 would still be lit, making it hard to determine the cause of the bad heater string. The natural assumption would be that one of the three unlit heaters was bad.

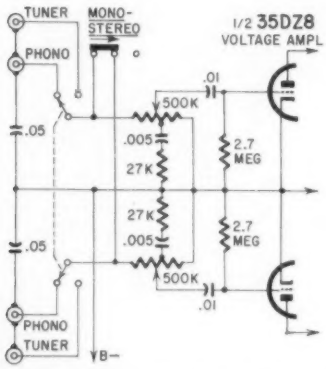


Fig. 2—Masco switches from single-ended 2-channel stereo to push-pull mono in their SA-202.

Controls and switches

Many sets use push-pull on–off switches. These let the listener leave the amplifier volume and tone controls preset at the proper positions. Turning the unit on does not interfere with these settings.

One kit, the Paco SA-40, has dual phono inputs so both a changer and turntable can be hooked up and switched in as desired. This is ideal if you don't want the kids playing their records on your turntable with its expensive arm and pickup.

Another feature that appears in some integrated units is switching the outputs to one of two or three external speaker systems. Puts hi-fi in any room of the house with a flip of the switch (it's on the amplifier's front panel). And of course, almost every unit has some kind of setting for checking balance.

Several types of balance circuits are used. They range from the very simple to the complicated. One of the simplest is that in the Harman-Kardon model A220. It is simply a 1-megohm pot connected across the two channels with its center tap connected to ground (Fig. 4). As it is turned one way it attenuates that channel, bringing its volume level down to match the other channel. When turned in the other direction, the reverse happens. The tone-control arrangements in this amplifier are also shown in Fig. 4.

Fig. 5 shows another type of balance control, used in the Bell Pacemaker and the Bell model 3030. Here two pots, each 500,000 ohms and one in each channel, are ganged in such a way that when the signal to one channel is increased (less resistance in the way) the signal to the other channel is

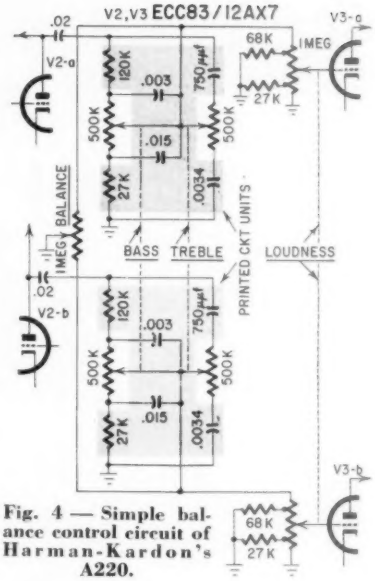


Fig. 4 — Simple balance control circuit of Harman-Kardon's A220.

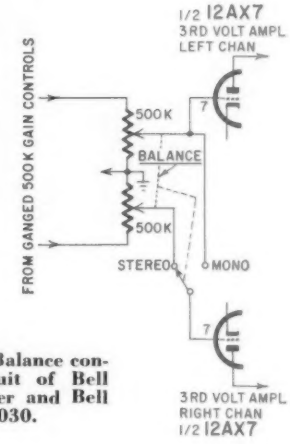


Fig. 5—Balance control circuit of Bell Pacemaker and Bell 3030.

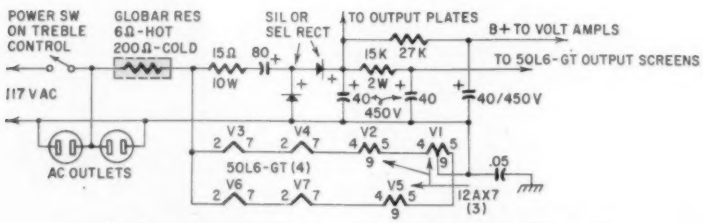


Fig. 3—Series-string heaters are used in one Arkay unit.

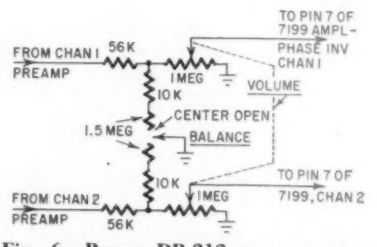


Fig. 6—Bogen DB-212 uses an open-center pot in its balance circuit.

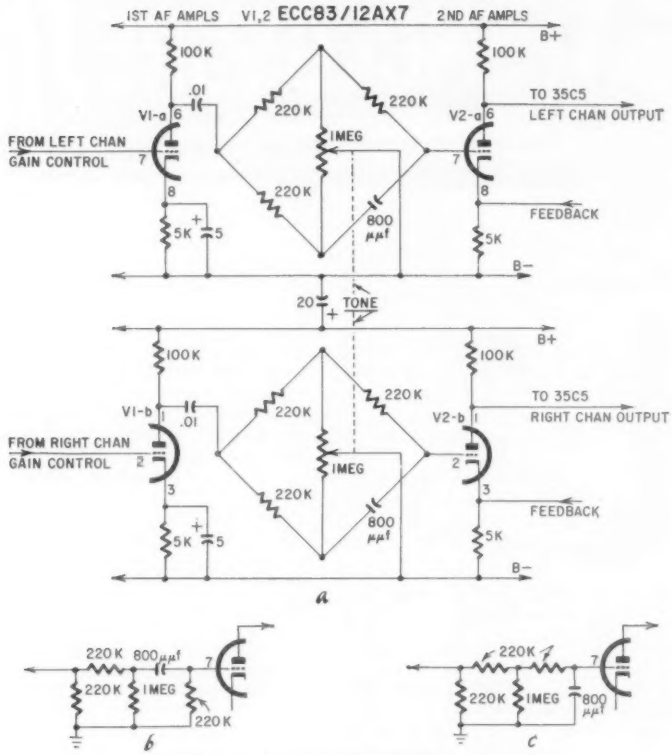


Fig. 7—A bridge type tone control is used by Radio Shack in the Stereolyne 7.

decreased (more resistance in the way). This control is also ganged to a stereo–mono switch, and in the extreme position switches the amplifier from stereo operation to mono.

Still another variation on the balance control is found in the Bogen model DB-212. A pot with an open center is used. The center arm goes to ground (Fig. 6). The two channels are kept completely separate but either one can be attenuated, independent of the other, to match its level to that of the other channel.

An interesting tone-control setup is found in Radio Shack's Stereolyne 7. Here a bridge type circuit is used (Fig. 7-a). With the ganged 1-megohm pots set in their mid-position, response is flat. But in the extreme clockwise position, it becomes a high-pass filter and removes the lower frequencies (Fig. 7-b), mainly rumble. At the other extreme of its rotation (counterclockwise), the control becomes a low-pass filter (Fig. 7-c) and removes the higher frequencies, including surface noise of worn records. Of course, the in-between settings provide variable amounts of attenuation.

Some of the Pilot amplifiers have an automatic turnoff switch. When the unit is placed in the automatic shutoff position and connected properly to a record changer, its ac supply is connected in parallel with the phono motor. When the motor goes off after the last record is played, the amplifier goes off

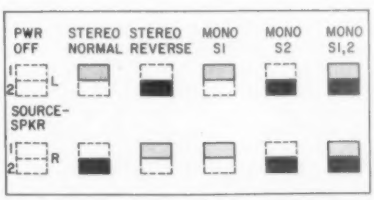


Fig. 8—From across the room, you can tell which mode of operation the Sherwood S-5000 is set up for. S1 and S2 refer to Speaker 1 and Speaker 2

too. Excellent for the hi-fi man who likes to go to sleep to music.

Many integrated stereo amplifiers have six possible operating positions: power off, stereo, reverse stereo, mono, channel A, mono channel B and mono channels A and B. How to tell which setting your amplifier is on is usually a job that calls for getting up from your chair and walking over to take a look. With the Sherwood S-5000 this problem is greatly simplified. Two control lights for each channel tell at a glance which arrangement is in use (Fig. 8). In the POWER OFF setting, no lights are on. In the stereo position, the top light for channel L and the bottom one for channel R are lit, and so on as shown in the diagram.

So much for circuit details. To make a real decision, you would probably like some specifications and prices. In the chart you will find a listing of many of the integrated amplifiers now on the market. They range from low to high power, from inexpensive to downright ritzy. But the one to pick is up to you. So take a look, and decide for yourself. Remember, once you've bought it, you're going to listen to it for some time. END

List of Manufacturers

ALLIED RADIO CORP., 100 N. Western Ave., Chicago 80, Ill.

ARKAY RADIO KITS INC., 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y.

BELL SOUND DIVISION, Thompson Ramo Wooldridge Inc., 555 Marion Rd., Columbus 7, Ohio

BOGEN-PRESTO CO., Div. of Siegler Corp., PO Box 500, Paramus, N. J.

DeWALD, Div. of United Scientific Labs Inc., 35-15 37th Ave., Long Island City 1, N. Y.

EICO, 33-00 Northern Blvd., Long Island City 1, N. Y.

ERIC ENGINEERING, 1823 Colorado Ave., Santa Monica, Calif.

FISHER RADIO CORPORATION, 21-21 44th Dr., Long Island City 1, N. Y.

GENERAL ELECTRIC CO., Specialty Electronic Components Dept., West Genesee St., Auburn, N. Y.

GROMMES, Div. of Precision Electronics, 9101 King Street, Franklin Park, Ill.

HARMAN-KARDON, INC., 520 Main St., Westbury, N. Y.

HEATH CO., Subsidiary of Daystrom Inc., Benton Harbor, Mich.

KNIGHT-KITS, Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

MASCO, Mark Simpson Mfg. Co. Inc., 32-28 49th St., Long Island City 3, N. Y.

PACO ELECTRONICS, Div. of Precision Apparatus Co. Inc., 70-31 84th Street, Glendale 27, N. Y.

PILOT RADIO CORP., 37-06 36th St., Long Island City 1, N.Y.

RADIO SHACK CORP., 730 Commonwealth Ave., Boston 17, Mass.

SARGENT-RAYMENT CO., 4926 E. 12th St., Oakland 1, Calif.

SCOTT, H. H., INC., 111 Powdermill Rd., Maynard, Mass.

SHERWOOD ELECTRONIC LABS INC., 4300 N. California Ave., Chicago 18, Ill.

SONIC INDUSTRIES INC., 19 Wilbur Street, Lynbrook, N. Y.

ALL ABOUT THE REFLEX ENCLOSURE

Part VIII—Putting our knowledge to use: speaker and port positions, suiting the speaker to the enclosure and the enclosure to the speaker

By P.G.A.H. VOIGT

THE standard—one might almost say the traditional—reflex cabinet is shown in Fig. VIII–1. The box baffle previously described has about the same general shape. Therefore, *one* way of turning that box baffle into a reflex enclosure is to replace the front with a new one of traditional appearance with port and speaker openings cut to suit the speaker in use.

The speaker will settle the details of the speaker opening. Its free-air resonance frequency can be measured as described in Part II (April, 1959). If the original 32 x 20 x 12½-inch cabinet was ¾-inch ply, well reinforced at all joints, the internal volume will be about 3¼ cubic feet. With speaker frequency and internal cabinet volume known, we have enough information to use the family of curves from Part II, Fig. II–7. For convenience, that family of curves is now repeated (Fig. VIII–2) and from it we can find the approximate area of a plain 4-to-1 rectangular port which will tune the air system to match the resonance frequency of the speaker.

The port-area information obtained from Fig. VIII–2 should be used only as a guide. Ports should be cut oversize and made adjustable, but on a more

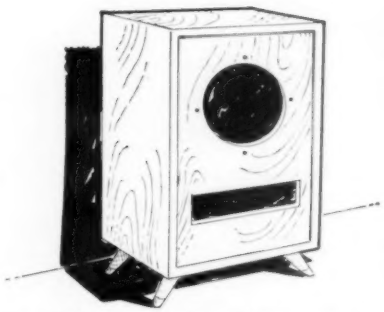


Fig. VIII–1—A reflex cabinet built in the traditional shape.

permanent basis than suggested in Fig. II–4 of Part II. In the case of a plain rectangular port, a bolt locked to a clamping strip as shown in Fig. VIII–3 and a wing nut passing through a hole in the cover provide a more permanent system. After adjusting the port as discussed in Part II to give the air system its correct frequency, the adjustment can be locked by tightening the wing nut.

If an 8-inch speaker with a free-air resonance of 58 cycles is to be used, we find from Fig. VIII-2, that the 4-to-1 port area to tune a 3¼-cubic foot cabinet to 58 cycles is about 16 square inches. A port adjusted to about 8 x 2 inches is suitable to start with.

When such a reflex system was tuned and tested the two impedance peaks came at about 38 and 79 cycles, respectively. That is about half an octave on either side of the basic resonances and with a total spread of roughly an octave. The upper peak is below the speech boom region, while the lower at 38 cycles insures that the low audio frequencies will not be lost altogether. This is therefore a useful combination.

Had the cone support been stiffer (which raises the resonant frequency) and the cabinet been tuned to match, the spread (measured in octaves) would have decreased and both peak frequencies would have gone up (the lower one considerably). Consequently, the low bass would have suffered.

When testing the 58-cycle 8-inch speaker with the 3¼-cubic-foot cabinet used as box baffle, the single peak came at 67 cycles.* A 30-cycle organ note

*I am indebted to Mr. O. C. Schwartz, trading as American Radio & T.V. Supply Co., of Toronto for the use of lab facilities to obtain these results and also the curves of Fig. VIII–2.

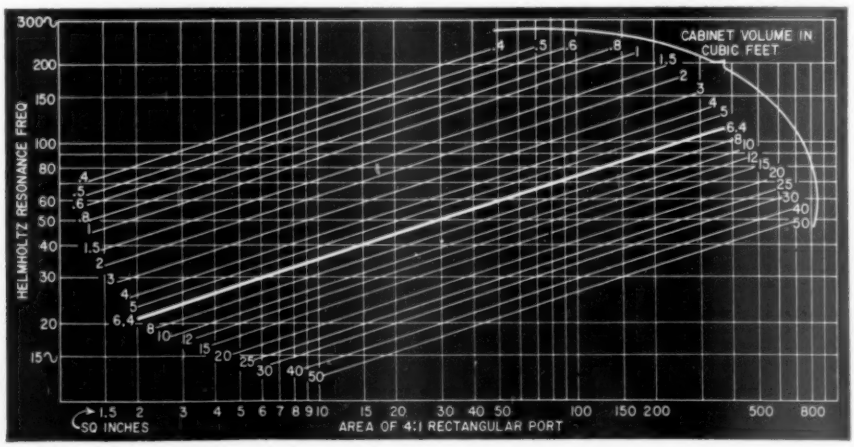


Fig. VIII–2—Relationships between Helmholtz resonance of reflex enclosures, port area, and cabinet volume.

comes more than one octave below that peak, so the efficiency there is much below that obtainable from the same cabinet when using reflex methods.

Now, when following existing designs, there is always danger of repeating the other fellow's mistakes. When designing the box baffle, the speaker was deliberately mounted near the mid-height of the cabinet in spite of the fact that a position higher up looked better.

The traditional position was rejected before because, with a speaker there, the vertical stationary wave corresponding to three half-wavelengths is excited effectively. It so happens that its frequency coincides approximately with that of the horizontal stationary wave of two half-wavelengths which is also excited. Such double excitation at a common frequency produces a major packet of trouble. By moving the speaker down to near the mid-height, that particular vertical stationary wave is not excited appreciably, so the coincidence is eliminated.

Even though the port opening will have some effect on the stationary-wave pattern in the cabinet, the same argument applies after conversion to reflex. Therefore, the box-baffle position for the speaker should be retained in spite of the inferior appearance.

How about the port?

The original front therefore remains suitable, and the only change required is that of cutting in the port opening. We thus come to the question, "What should be the shape of the port?"

Should it be round or square, should it have the customary rectangular shape, and if so, should it be four times as long as it is high or should it be as long as possible? If it is to be distinctive, what about a diamond shape or triangular? If it is to be ornamental, what about the shape of the f-holes in a violin? The possibilities seem endless.

As far as tuning is concerned, we know that the area required to tune the air cushion depends to some extent on the shape of the port. However, no matter what that shape might be, provided the area is big enough in the first place, we know from Part V (July, 1959) there is always one adjustment of port area at which the desired air inertia factor is obtainable. As far as tuning is concerned therefore, any shape will do.

With some port shapes there will be more air friction than with others; with multiple ports in particular more air friction can be expected. The Q will therefore vary, but this is a minor matter and the Q may have to be damped down anyway.

The port shape can therefore be selected on the basis of secondary factors which will be discussed later.

The original box baffle was regarded as suitable for an 8-inch and certain 10-inch speakers, but too small for a normal 12-inch speaker. Will this also

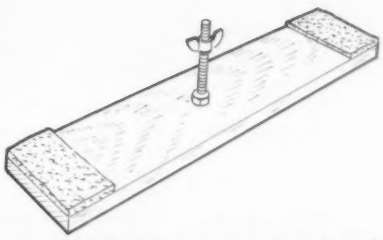


Fig. VIII–3—Clamping strip with padded ends. The bolt is locked to the wood strip.

apply if the cabinet is converted into reflex?

Well, we know that if a larger speaker is used with a given cabinet, the coupling increases and this increases the spread between the peaks. With a 12-inch speaker, for example, the coupling is more than double that with an 8-inch speaker. The natural frequency of the speaker affects matters also, and the better large-size speakers usually have natural resonance frequencies well below 60 cycles.

Suppose therefore that we have a large speaker with a resonance at 50 cycles and of such size that the cabinet coupling produces a peak spread of about two octaves. The upper peak then occurs at 100 and the lower at 25 cycles. This goes down below the important audio frequencies, so the normal low range should be reproduced well, but the upper peak frequency is dangerously close to the speech boom region.

Deliberate mistuning in this case does not seem helpful. A lower-frequency speaker, so that with the cabinet tuned to match, both peaks would go down the scale, would be better. (Any trouble from motor rumble should be cured at the source.) Still better would be the use of a larger cabinet as well, with its reduced coupling and consequently reduced peak spread. This will provide the additional advantage of a naturally lower cabinet Q.

A bigger cabinet with external dimensions of 37½ inches high x 23⅞ inches wide x 16 inches front to back made of ¾-inch ply and reinforced at all junctions has an internal volume of about 6.4 cubic feet. The ply can be cut out of a single sheet measuring 4 x 8 feet. In a system using such a cabinet with a 10-inch 35-cycle free-air-resonance speaker, the lower and upper peaks came at about 20.5 and 54 cycles, respectively (about 1.3 octaves spread). The upper peak is well clear of the speech region but the lower one is unnecessarily far down the scale. However, using damping as discussed in Part VI (Aug., 1959) (Fig. VI-4), no trouble from rumble occurred with a good turntable, while reproduction of low organ notes, though requiring plenty of power, was impressive. A 10-inch speaker with a somewhat higher natural frequency would have worked well in this cabinet. A 12-inch speaker with a 35-cycle resonance would have been OK too, though a larger cabinet would have been preferable. Larger cabinets are certainly appropriate with still larger speakers, provided the domestic situation permits!

Port position

In the case of the speaker opening, we found that the traditional layout, though desirable on grounds of appearance, would have been a mistake acoustically. If the traditional position of the port has been arrived at because it "looks right" there, then that too might be an acoustic mistake.

Before cutting port openings into good plywood, let us examine this question. In the theoretical discussion of the Helmholtz resonator, the internal volume is concerned—as far as tuning goes—only with being associated with a port arrangement having the correct air inertia factor. Whether that air inertia factor is concentrated in and around a single port or is the combined effect of several ports in parallel matters not at all.

The exact area required varies with conditions. It is reduced with multiple or slot-shaped ports and increased when the bulging air regions near the port cannot develop fully, as, for example, when the port is close to the sides or bottom of the cabinet. From the primary point of view, these variations do not have special significance and so all that matters as far as tuning is concerned is that the port area be adjusted to give the correct air inertia factor. There are however secondary factors which are well worthy of consideration.

A loudspeaker, considered purely as a piece of electromagnetic machinery, has for its prime object the conversion of electrical into sound energy.

If it did this without distortion and at uniform efficiency, then it would automatically have a uniform audio response with respect to the energy delivered into the room. Ideally, of course, it should radiate the sound uniformly into that room as well and have no hangover. At this stage, let us consider energy-conversion efficiency alone.

"Now if we can get them going together, it ought to sound like stereo!"

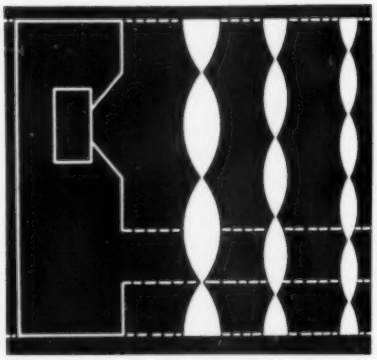


Fig. VIII–4 — Curves show pressure buildup in vertical stationary waves when there is no port.

A cone has two sides and we have discussed how unwanted stationary waves are set up inside the cabinet. At the frequencies at which these occur, the load on the rear of the cone is affected. Any alteration of the load affects the cone motion and therefore just at each of these frequencies the coil motion is affected too. This shows as an irregularity in the impedance curve of the speaker, and also affects the matching between the amplifier and coil, thus slightly altering the energy output to the coil.

This energy is shared between the coil and the cone with its front and rear surfaces. When the rear load changes from frequency to frequency as the stationary-wave pattern changes, the proportion in which the incoming energy is divided between front and rear varies too. This causes irregularities in the forward response. Further, when the signal ceases, the energy in the stationary waves within the cabinet will cause hangover.

Now when a port is cut into a cabinet, internal conditions are disturbed. Every stationary wave tends to build up pressure regions in certain places. If there is a port just there, that pressure is partially released and sound is radiated, with consequent reduction of the build-up of that wave. It may even be killed more or less completely.

A port cut in the usual place in the cabinet therefore affects most those vertical stationary waves that would have had maximum pressure regions just there if there had been no port. From Fig. VIII–4 it will be seen that the stationary waves with 3, 4 and 5 half-wavelengths would be greatly affected by a normal port in the usual place. The stationary wave of two half-wavelengths has its maximum pressure levels at mid-height and at the top and bottom, so a port in the normal position hardly affects it. The single half-wavelength standing wave has only two pressure regions, one at the top and the other at the bottom of the cabinet. The port therefore has some effect, but not as much as if it were located at either end.

With the speaker at just above mid-height as suggested, we avoid setting up appreciably the 1-half-wavelength and the 3-half-wavelength modes, but we do set up the 2-half-wavelength mode, and also the 4th and 5th to some extent. Now all these vertical modes have one thing in common—they have pressure maxima at the two ends: top and bottom of the cabinet.

If the port is shifted to either end, or divided and half placed at each end, *all* vertical stationary waves will be affected by the port's pressure release action, and since their energy is being radiated, they will be damped, possibly even killed.

They could be absorbed by using deliberate damping material and so turning their energy into heat. However, at the frequency at which they are effective, they steal power from the rear of the cone and so the frontal radiation is affected. So it seems to be more sensible to turn their energy into sound in the hope that this will make up to some extent for any forward loss.

The secondary action of the port—the way it affects the internal standing-wave pattern—can thus be used to advantage by placing the port so as to damp the unwanted stationary waves and turn the residue to use.

As far as the vertical stationary waves are concerned, this means putting the port at either end or splitting it and having ports at both ends.

Now, if two equal ports are used, the effect at low frequencies is as though the sound originates midway between the two. An arrangement using two equal ports placed symmetrically about the speaker therefore behaves as though the speaker and port positions coincide.

In Part II, when discussing the lower impedance-peak frequency—at which speaker and port flow are in opposition—it was pointed out that cancellation could not be complete, even if the opposing quantities were alike, *unless* all path lengths to the listener's ear were of equal length. Such equality of path length occurs if cone and port coincide. Ports divided and located symmetrically about the speaker therefore diminish the efficiency of reproduction of the extreme low frequencies.

To prevent this, the distance between the cone and the mid-point between the ports should be as great as practical. This requires that the port or ports be either at the top or at the bottom of the cabinet. The next question is therefore, "where should the port or ports be, top or bottom?"

TO BE CONTINUED

REDUCES PA HOWL

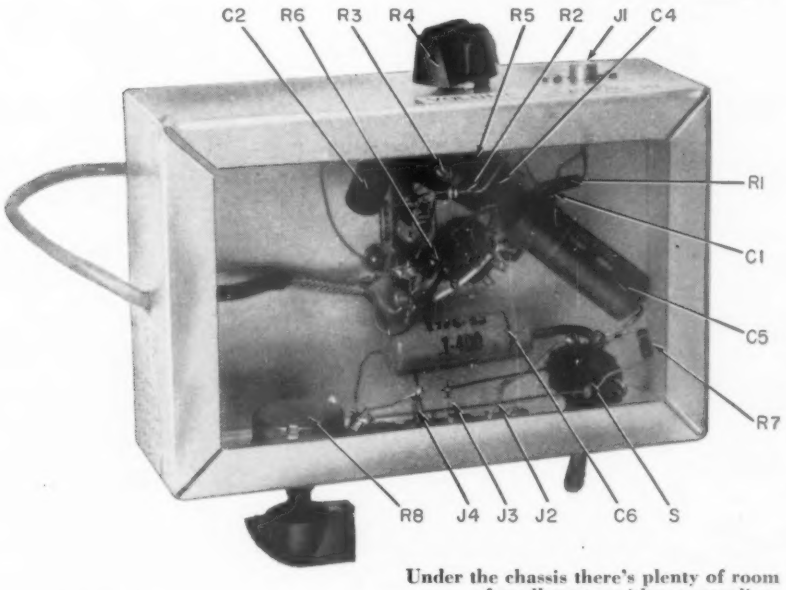
Feedback howl caused by room reverberations is minimized by a new frequency-shifting device developed at Bell Laboratories. The new method permits turning up the gain of an indoor system to roughly double that of conventional equipment before any instability problems arise.

The feedback-squelching apparatus was developed by Dr. Manfred R. Schroeder, who in 1954 formulated a theory of response fluctuations inside a room. Its central feature is a frequency-shift modulator, which creates a frequency shift of the sound equal to the period between the major peaks and adjacent valleys of the room's gain response characteristic. Thus the peaks, instead of reinforcing each other and rapidly building up to oscillation, tend to be absorbed in the valleys of the room's response characteristic. The frequency shift required is approximately 5 cycles per second, and is inaudible in speech and most types of music.

ADAPT YOUR TAPE RECORDER TO RECORD STEREO

Back panel of the adapter has output jacks and bias control. Volume control and input jack are on the front panel.

Simple 1-tube adapter turns any tape recorder with stereo playback into a 2-channel stereo recording device



Under the chassis there's plenty of room for all parts, without crowding.

By PETER A. STARK

ONE tube is all it takes to convert almost any tape recording machine to stereo recording, if it already has a stereo playback head. If it does not, it is a simple matter to add the head since most manufacturers offer head conversion kits for their recorders. Alternatively, an adapter mounted on the side of the recorder's case can be used.

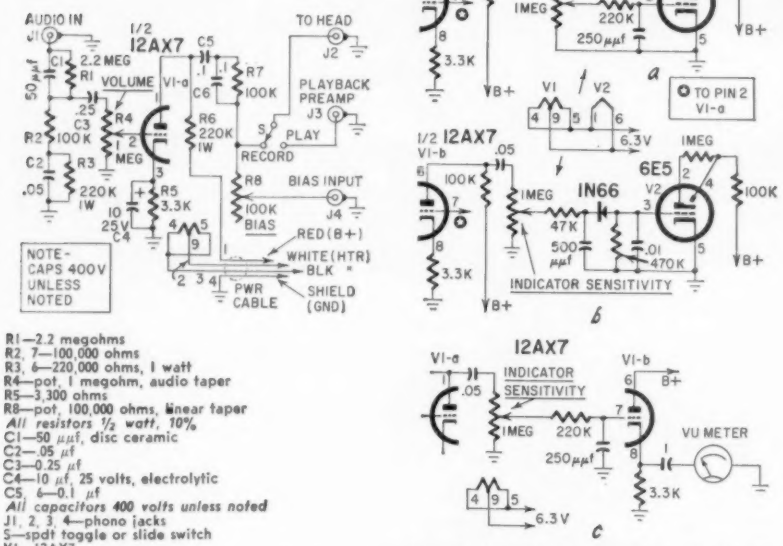
Basically, the adapter is a single-stage amplifier with appropriate equalization and bias mixing. It doesn't have a high-gain microphone preamplifier, since it is seldom that an amateur does any live stereo recording. Similarly, it doesn't have its own power supply or bias oscillator since these are already in the recorder and need not be duplicated. For the sake of simplicity (as well as low power drain) there is no volume indicator. Since this adapter will probably be used for copying records and tapes, or for off-the-air recording, it is easier to determine experimentally the optimum setting of the volume control first and then simply use the same setting for every recording.

As seen in Fig. 1, the input signal applied to jack J1 is equalized by the

Recorder response follows standard curve within 2 db. Some slight distortion is measurable, but not audible. Excellent unit for simple conversion of mono recorders to stereo. Also stereo tape machines that do not have dual record amplifiers.

One point to keep in mind: the record curve of your tape recorder may not match the record curve of the adapter. If this is so, adjust the adapter's equalizing network to get as close a match as possible. Minor differences in record curves can show up when listening to a stereo playback.

Fig. 2—Three circuits for adding a level indicator to the adapter.



R1—2.2 megohms
R2, 7—100,000 ohms
R3, 6—220,000 ohms, 1 watt
R4—pot, 1 megohm, audio taper
R5—3,300 ohms
R8—pot, 100,000 ohms, linear taper
All resistors ½ watt, 10%
C1—50 μμf, disc ceramic
C2—.05 μf
C3—0.25 μf
C4—10 μf, 25 volts, electrolytic
C5, 6—0.1 μf
All capacitors 400 volts unless noted
J1, 2, 3, 4—phono jacks
S—spdt toggle or slide switch
V1—12AX7
Chassis, 5 × 7 × 2 inches
Length of 3-conductor shielded cable (shield acts as fourth conductor)
Miscellaneous hardware

Fig. 1—Circuit of 1-tube adapter.

network consisting of C1–R1–R2–C2–R3 and applied to the recording volume control, R4. After amplification, the signal passes through a treble-boost network consisting of C6 and R7 to the switch and through to J2. The incoming bias signal applied to J4 is also mixed with the audio at this point. Potentiometer R8 permits precise adjustment of the bias current. The circuit is straightforward, reliable and completely uncritical as to parts placement.

The original unit was built into a 4 x 2⅛ x 1⅝-inch Minibox, except for the volume control and record–play switch, which were mounted externally. The later version, shown in the photos, uses a 5 x 7 x 2-inch chassis for the greater amount of space available.

How to hook it up

With the stereo head installed, one side of it is connected in place of the old monaural head. The other side should be connected to J2 of the adapter with a good quality shielded lead. Ordinary audio cable may have a capacitance of over 100 μμf per foot, and will shunt the bias signal to ground. It may even resonate with the head and cause very ragged frequency response. Using, at most, a foot or two of RG-59/U coaxial cable, rated at 21 μμf per foot, connect the head to J2 and the playback preamp to J3. Most modern hi-fi preamps have a "tape-head" input, and it can be used.

Next, use a very short length of unshielded two-conductor wire to connect J4 to the erase head. One side of the head is usually grounded. Connect this terminal to the outer ring of J4. The head's "hot" terminal is connected to the inner terminal of J4. Now connect the power cable to the appropriate points in the recorder. If possible, the B-plus lead should go to some source of 150–250 volts which has high voltage only when the recorder's controls are set for recording.

Since the adapter loads the recorder's bias-erase oscillator slightly more than before, the bias level may have to be readjusted. Connect a 100-ohm resistor in series with the head (in the ground lead), measure the bias voltage drop across it, and calculate the bias current. Adjust both channels to conform with the head manufacturer's recommended bias current, by adjusting R8 in the adapter and, if necessary, by changing the value of the series resistor in the recorder until proper bias current is obtained.

Now connect the tuner or preamp which will be used, to J1. An audio signal of at least 1.5 volts is needed for sufficient recording volume level. Adjust the volume control setting for correct volume either by pulling out the bias oscillator tube and using a vtvm to compare the levels in the adapter channel and in the presumably correct main channel, or by recording a tape and comparing it with other tapes in your collection. Mark the control setting so it can be used whenever you record from the same source. If you feel a volume indicator will help, you can try one of the several circuits in Fig. 2. Since the adapter uses only one half of a 12AX7, the other half becomes a voltage amplifier for the indicator.

The adapter is an economical way for a hi-fi enthusiast to try his hand at stereo recording, since it eliminates all unnecessary parts without sacrificing quality of reproduction. END

ELECTRONICS BEATS PARKING METER

A Franklin Manor, N.J., man was determined that he shouldn't have to pay a $1 parking ticket for overtime parking at a 30-minute meter.

He didn't pay it either. But he had to use an electronic stethoscope, a temperature-humidity sensitive time tape and an electronic brain to win.

Arnold Sprinz, 28-year-old aeronautical engineer at Picatinny Arsenal, presented in court a metered receipt, obtained with precision monitoring equipment, to prove that the meter short-timed him by five minutes.

Here's what Sprinz did:

He borrowed an electronic stethoscope, similar in principle to those used by doctors to listen to heartbeats. He used the transistorized, battery-powered instrument to pick up the tick-ticking of the meter, into which he had dropped another nickel.

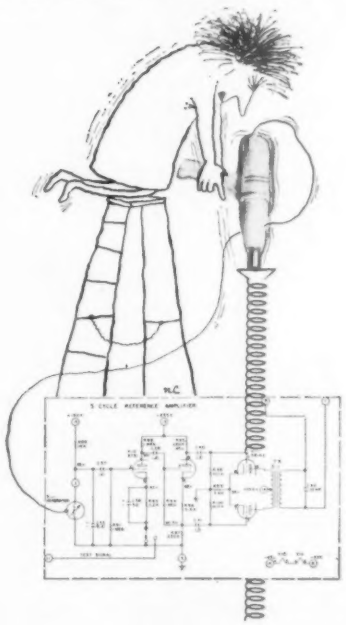
The normal parking meter runs 120 beats to the minute, he said. This particular meter was four minutes fast and the mechanism that sends up the red flag was another minute ahead.

That meant his time was up five minutes before it really was electronically.

Next Sprinz compared his recording with a humidity and temperature sensitive time tape and clocked off 30 minutes for comparison. Finally he dumped his data into an electronic brain (loaned gratis by a friend) and came up with his metered receipt.

"It wasn't the dollar but the principle of the thing," said Sprinz.

"Case dismissed," said the judge, citing that the city failed to prove the charge.—*Morristown Daily Record*



Five transistors and simple circuitry put you on the air with 2½-mile range on one of 22 available channels

TRANSISTOR TRANSCEIVER for CITIZENS RADIO

By FLOYD DUCOTE* and HARRY COOKE*

AN all-transistor transceiver has considerable appeal to the amateur and experimenter, and also is an extremely useful item that has commercial possibilities. The transceiver described here uses only five transistors, is small in size, light in weight (approximately 1 pound, including antenna) and uncomplicated in design.

Because of the low impedance and voltage levels required, it has been possible to design a unique and extremely simple transmit–receive switching system using one dpdt snap-action switch. Under open field conditions, a pair of these transceivers provide a maximum two-way communication range of approximately 2½ miles.

Transmitter

Fig. 1 shows the transceiver's schematic. The crystal-controlled oscillator and power amplifier circuits use two Texas Instruments diffused-base, or mesa, transistors. V2 is operated as a crystal-controlled Hartley oscillator with the crystal acting as the feedback element between the emitter and the tap on the tank coil. Since the diffused-base transistor has an alpha cutoff frequency greater than 90 mc, there is no difficulty in obtaining dependable oscillation at 27 mc.

The variable capacitor, C7, resonates the tank circuit at the crystal frequency. The signal that drives the base of the modulated class-C power amplifier, V1, is tapped off L2. The power amplifier tank coil, L1, is tapped to match the 50-ohm antenna to V1's output resistance. Capacitor C1, 500 $\mu\mu$f, connects the output to the antenna.

*Texas Instruments, Inc., Dallas, Tex.

BENCH TESTED

A transceiver following the specifications of this article was built up by I. Queen of our staff, and tested at the laboratory of a major communications equipment manufacturer. Results of these tests show that at any frequency at which the transmitter section can be set (using a 27.075-mc crystal), frequency variation is less than 1,000 cycles. At one particular setting (varies from unit to unit because of minor construction differences and component tolerances), frequency variation was less than 10 cycles.

This does not mean that any set constructed by a reader will fall within equally close tolerances, even if layout and components are duplicated as closely as possible. **Wherever possible, the completed job should be checked out by a service technician who holds the second-class license permitting him to work on such transmitting equipment.**

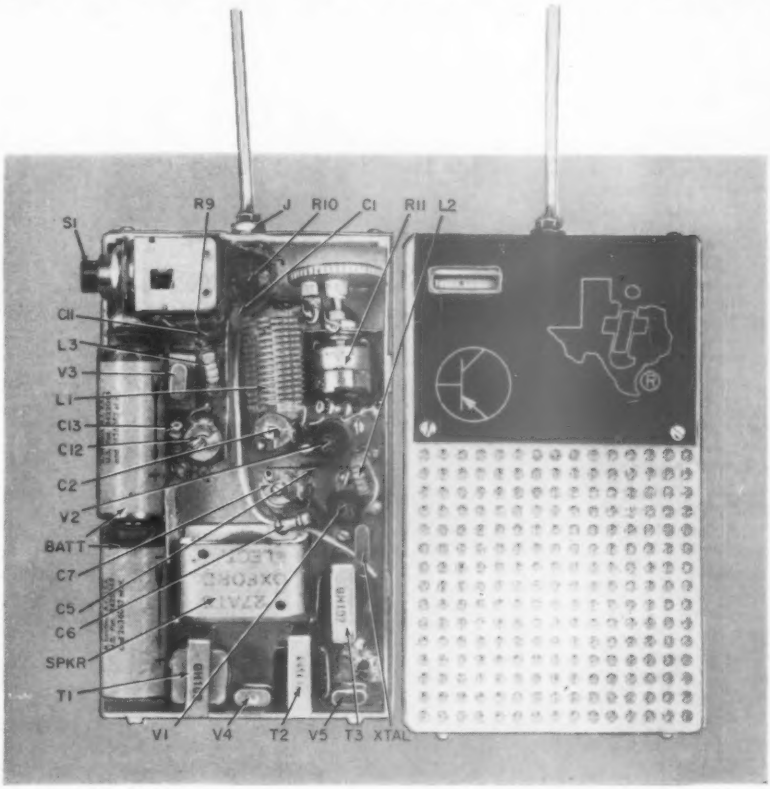


Photo 1—Front and rear views of the transceiver built by Texas Instruments.

Collector modulation is used to get the greatest efficiency for a given collector power. The bottom end of L1 is bypassed for rf by a .01-μf capacitor but the collector voltage is obtained from T3's primary, which acts as a modulation choke. Transformer T3's secondary is open during transmission and, in effect, is not in the circuit. Transistor V5 is a medium-power audio device operated as a class-A modulator. The audio drive for the modulator comes from V4, a conventional class-A amplifier.

In the transmit position, the speaker acts as a microphone and is matched to V4's input by an additional 12-ohm winding on T1. The transformer's original 20,000-ohm primary is used in the receive position. Since the audio gain of V4 and V5 is more than sufficient to produce 100% modulation, an attenuator is used at the modulator input—across T1's 12-ohm primary.

The input power to the final stage, V1, is approximately 30 mw, while the power output to the antenna is 20 mw. This is a good indication of the excellent efficiency (65%) of the diffused-base transistor. The antenna is center-loaded to present a 50-ohm resistance at its bottom end. Construction of the antenna is shown in Fig. 2. One end of the antenna is filed down for a snug fit in the antenna post (J), which is a miniature phono jack.

Receiver

The receiver uses a 2N309 self-quenching superregenerative detector. The circuit is a variation of the two-terminal grounded-base oscillator, with feedback provided by a 4.7-$\mu\mu$f capacitor between the collector and emitter. RFC4 is a 22-μh choke that is self-resonant at approximately 27 mc. This elevates the emitter from ground at the signal frequency and makes oscillation possible. The 220,000-ohm base-bias resistor and the .001-μf bypass capacitor produce a quench frequency of approximately 50 kc. In general, a lower quench frequency provides better sensitivity but is more difficult to eliminate from the audio amplifier. The .01-μf capacitor, C15, prevents the quench voltage from overloading the audio amplifier.

PARTS LISTS

R1—430 ohms, 5%
R2, 5—18,000 ohms
R3, 6, 13—2,200 ohms
R4—470 ohms
R7—220,000 ohms
R8, 14—1,000 ohms
R9—10 ohms
R10—33 ohms
R11—pot, 20,000 ohms
R12—15,000 ohms
R15—8,200 ohms
R16—1,200 ohms
R17—100 ohms
R18—220 ohms
All resistors ½-watt 10% unless noted
C1, 11—500 μμf, ceramic
C2, 7, 12—3-30 μμf, air trimmer
C3, 4, 5, 6, 8, 9, 15—.01 μf, ceramic
C10—.001 μf, ceramic
C13—4.7 μμf
C14—40 μf, 3 volts, electrolytic
C-16, 17, 19, 20—.005 μf, 3 volts, electrolytic
C18, 21—.005 μf, ceramic
C22—100 μf, 15 volts, electrolytic
All capacitors 75 volts unless noted. Subminiature units only
BATT—5-volt mercury batteries in series (2) (Mallory TR-164-R or equivalent)
L1—14 turns, tapped at 3 turns (Air Dux No. 416, B&W Miniductor No. 3003 or equivalent)

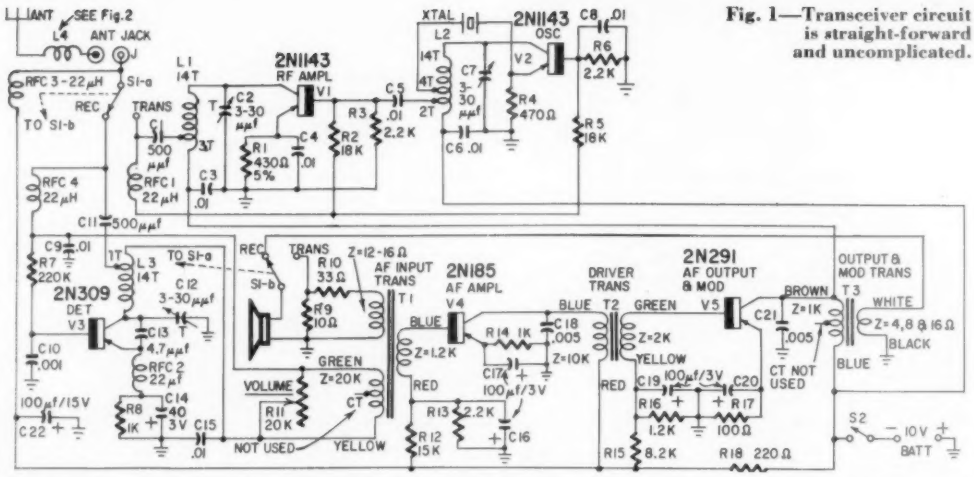


Fig. 1—Transceiver circuit is straight-forward and uncomplicated.

L2—14 turns, tapped at 2 turns and 4 turns (Air Dux No. 416, Miniductor No. 3003 or equivalent)
L3—14 turns, tapped at 1 turn (Air Dux No. 416, Miniductor No. 3003 or equivalent)
L4—44 turns, centered on ½-inch polystyrene rod (see Fig. 2) (Air Dux No. 432, Miniductor No. 3004 or equivalent)
RFC1, 2, 3, 4—22 μH (Delevan 1537 series or equivalent)
S1—dpdt snap-action switch (Minneapolis Honeywell 2-PB11-T or equivalent)
S2—spst
T1—dual-input transformer: primary, 20,000 ohms; secondary, 1,200 ohms—modified by adding a second primary of 80 turns of No. 38 enameled wire for the speaker input-output windings (Gramer-Halldorson GH109 or equivalent)
T2—driver transformer: primary, 10,000 ohms; secondary, 2,000 ohms (Gramer-Halldorson GH-117 or equivalent)
T3—output transformer: primary, 1,000 ohms; secondary, 12-16 ohms (Gramer-Halldorson GH107 or equivalent)
V1, V2—2N1143 (see text)
V3—2N309
V4—2N185
V5—2N291
Speaker (Oxford 27AT5 or equivalent)
Case
Antenna (see Fig. 2) 26½ inches long, made from ⅛-inch brass rod
Knob for volume control
Miscellaneous hardware

The detected audio voltage is developed across T1's 20,000-ohm primary. Collector voltage for V3 is supplied through this same primary winding. A 20,000-ohm volume control across the primary controls the level of the received signal. V4 is a simple voltage amplifier, and V5 is a class-A audio output which drives the 3-ohm speaker. The receiver requires a 5-μv signal to get a 10-db signal-to-noise ratio.

The transmit–receive switching system is possible because of the low impedance and voltage levels associated with transistors. The 22-μh chokes have low dc resistances, so any voltage drops are negligible. On the other hand, the Q's are high enough so that the chokes can shunt an rf signal circuit with very small loss.

In the RECEIVE position (as shown), S1-a and RFC3 carry the supply voltage via RFC4 to V3's collector and base, thus activating the receiver's detector. The signal from the antenna also travels through S1-a to the tap on L3 which is the receiver's signal input. In the receive position, S1-b connects the speaker to the audio amplifier's output. When the switch is pressed, S1-a connects the antenna to the rf power amplifier's output at the tap on L1. At the same time, the —10-volt supply is connected to the forward bias resistors on V1 and V2, causing them to become operative. The audio amplifier's input is connected to the loudspeaker (which is now the microphone) by S1-b.

The layout is not particularly critical but good rf practices should be observed, especially in the transmitter circuitry.

The transmitter is tuned by adjusting C7 for maximum output as indicated by a grid-dip meter placed close to L2. After C7 has been tuned, the grid-dip meter is moved to the antenna near the loading coil and C2 is adjusted for maximum output.

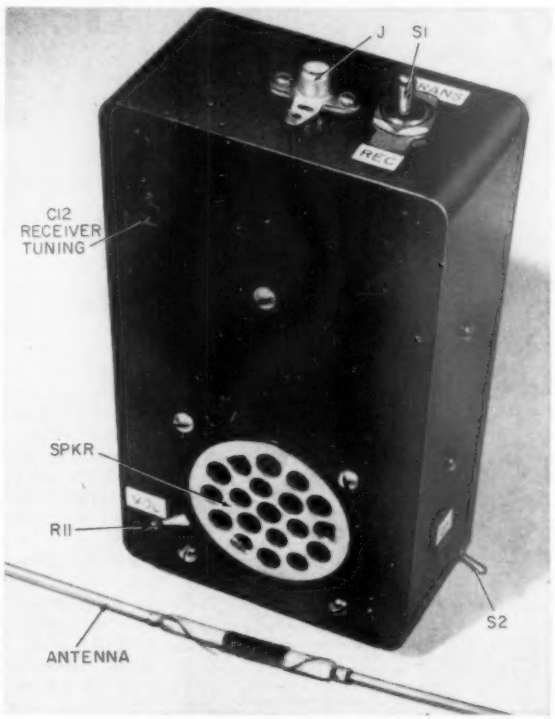


Photo 2—Front view of the R-E Citizens Radio transceiver.

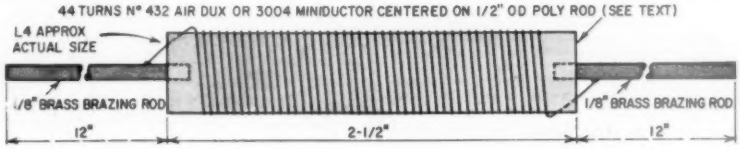

44 TURNS N° 432 AIR DUX OR 3004 MINIDUCTOR CENTERED ON 1/2" OD POLY ROD (SEE TEXT)
L4 APPROX ACTUAL SIZE
1/8" BRASS BRAZING ROD
1/8" BRASS BRAZING ROD
12"
2-1/2"
12"

Fig. 2—Construction of the center-loaded whip antenna.

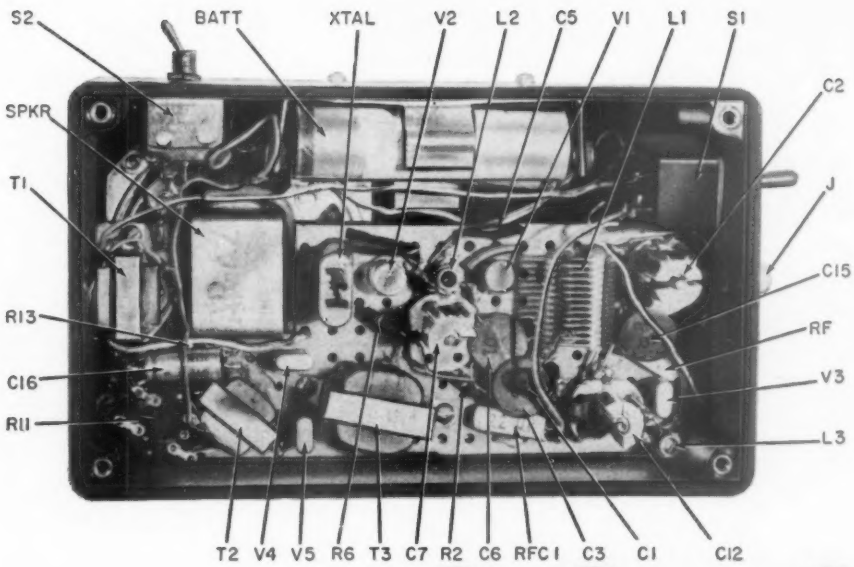
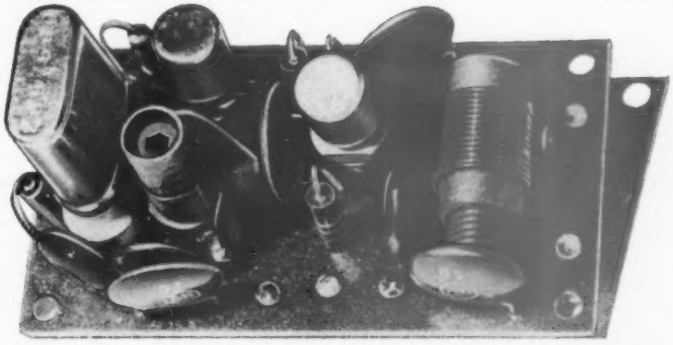


Photo 3—Inside the compact R-E transceiver.

(Below) A 2-transistor printed circuit transmitter rf chassis developed by International Crystal Mfg. Co. for Citizen's Band radio. It might be used in the transistor transceiver described in this article to help the constructor who feels that he may have difficulty in building a unit that will be on frequency and within tolerance.



The receiver's frequency adjustment, C12, can be made either with a signal generator or with another transmitter. The detector has very good limiting characteristics, so the signal used for tuning must be very small.

If two of these transceivers are operated within 50 feet of each other, the radiated signal from the detector of one receiver may be picked up by the other receiver.

Construction Details

L2 and L3 were wound on Ferramic Q toroidal cores to conserve space. Since these cores are not always available through parts jobbers, their equivalents in standard helical coils are given. The crystal is a postage-stamp type specially constructed for these transceivers but standard types of crystals will work just as well.

To add the 12-ohm primary to T1, the frame and core must be removed from the transformer. The outside tape must also be removed before winding on the new primary. Since the audio amplifier's gain is more than adequate, the additional winding can be reduced to 40 turns for easier winding. The original windings should not be disturbed when making this modification.

Editorial note

The transceiver in Photos 3 and 4 was constructed by Mr. Queen of the RADIO-ELECTRONICS staff and completely checked out by a radio engineering laboratory to insure that you can duplicate it with the assurance that it will meet FCC specifications. Some components in the original unit were replaced by types that are more readily available and case dimensions and parts layout were adjusted accordingly.

The 2N1143 transistors used in the transmitter section are comparatively expensive—around $16 each. Less expensive high-frequency transistors with approximately the same characteristics as the 2N1143 were tried as possible substitutes but did not work well in this circuit.

In the RADIO-ELECTRONICS transceiver, L1 is 14 turns of a B & W type 3011 Miniductor with the tap 3 turns from the "cold" end. L2 and L3 are each 18 turns of No. 30 enameled wire closewound on CTC (Cambridge Thermionic Corp.) PLS6 forms. L2 is tapped at 3 and 6 turns, and L3 at 1½ turns. L4 consists of 44 turns of No. 26 enameled wire closewound on a ¼-inch diameter polystyrene rod 2 inches long. The ends are drilled to receive the brass antenna rods. The ends of L4 are soldered to the rods as in Fig. 2.

C1, 2 and 3 are E. F. Johnson type 30M8 3–32-$\mu\mu$f 28-plate variables with one rotor and one stator plate removed from the rear and the shaft cut down slightly to fit the cabinet used.

RFC-1, -2, -3 and -4 are National type B15978 22-μh inductors.

T1 is a Lafayette type AR-104 input transformer with a 50-turn primary of No. 38 enameled wire added to match the 3.2-ohm speaker. Adding this winding is a tedious job and extreme care is needed to avoid breaking the wire or damaging the original windings and to prevent shorts to other windings or the core.

T2 is a Lafayette AR-109 and T3 is an AR-138. An output transformer with a 3.2-ohm secondary was selected to match the 3.2-ohm speaker which is easier to obtain than 12- or 16-ohm miniature types.

R11, the volume control, is a 15,000-ohm potentiometer which was the closest to the specified value in a miniature type.

The bakelite case and cover are Lafayette MS-216 and MS-217, respectively.

The crystal must be a third-overtone type cut for the desired Citizens radio channel. Its frequency tolerance must be .005% or better. **Manufacturers guarantee the frequency tolerance of their crystals only when they are used in the circuit used for calibration. In this and many other oscillators, tuning the tank circuit causes variations in output frequency. Therefore, the transceiver's oscillator must be tuned by or under the supervision of a commercial radio operator with a Radiotelephone Second-Class or higher-grade license.** You can have your transceiver tuned and checked out by the technician who normally services fire, police, public utility or marine radiotelephone equipment in your area. An operator at a broadcast station may have the equipment to do the job for you. END

RADIO

REJUVENATION for the AM Detector

AM detector uses voltage-doubler action—drives audio output stage direct

By LEONARD E. GEISLER*

FOR years, radio manufacturers have been foisting the diode detector circuit (Fig. 1-a) and its low-level highly distorted audio output onto an unsuspecting public. (Don't think output is distorted? See Fig. 1-b.)

Many serious workers have explored various types of detectors, looking for one which would yield high output with low distortion. None, however, is nearly as perfect as that which we shall describe here. The use of negative feedback techniques to reduce conventional detector distortion has been described,[1] but apparently not adopted.

On the other hand, we have developed a very simple, inexpensive detection system which neatly sidesteps most, if not all, failings of the conventional detector. Using either tubes or semiconductors, this detector reproduces *all* the information on the original carrier —excepting sidebands lost during rf and if amplification—without introducing appreciable distortion of its own. (This *is not* an original circuit; it is the familiar half-wave voltage doubler.)

What it is and how it works

The circuit uses a pair of diodes—vacuum-tube or semiconductor—*wired as a simple diode integrator.* Parts used are at an absolute minimum (see Fig. 2). Values of C1 and C2 are usually 47 and 470 $\mu\mu$f, respectively. R1 may be from 250,000 ohms to 2 megohms. The output coupling capacitor can be any value from .001 through 0.1 μf to suit individual taste.

When a modulated rf wave is introduced at point A, the negative-going portion of the sine wave causes D2 to conduct and both C1 and C2 are placed in series across the input. Both capacitors are presented with the same amount of input voltage from the if transformers, but since C1 is much smaller than C2, most of the charge appears across it. As the wave falls back through zero and to its maximum positive excursion, D2 is cut off and C2 is effectively isolated from point A. D1 now conducts, discharging C1. At this time, point B has a charge of approximately $\left(\frac{C1}{C2}\right)$ V. As the wave proceeds to its maximum positive value, D1 still conducts heavily and does so until the wave, reversing, reaches the zero line once more. When the next negative-going portion arrives, D2 does not conduct until the voltage at point A exceeds the charge at point B. The voltage presented to C1 and C2 is therefore slightly less than on the first negative wave. However, the potential at point B rapidly builds up to the peak-to-peak value of the input waveform. By inserting R1 between point B and ground, the charge on C2 is bled off to produce a useful output. The additional resistor and capacitor (R2 and C3) shown between X and ground provide a takeoff point for recovery of avc bias. A useful byproduct of this R-C circuit is that it acts as a bass-boosting device at low settings of R1. If it is undesirable or sound is too high in the "off" position use a volume control near the 2-mehohm value, or replace it with a 250,000-ohm fixed resistor and put a 500,000-ohm volume control directly between amplifier grid and ground.

Due to the unbalanced manner in which the conventional diode detector loads the if transformer's secondary, the diode fails to produce undistorted af output. The diode integrator–detector, on the other hand, presents essentially a capacitive load to both the positive and the negative excursions of the rf waveform. C1 appears in parallel with the trimmer capacitor on the if transformer secondary and therefore the action of the detector has little effect on the tuned circuit. What additional capacitance there is can be trimmed out and the secondary of the if transformer is in resonance once more. Therefore, this is essentially a no-load detector. It allows maximum output voltage to be developed, something practically impossible with conventional methods of detection. Rectified rf dc voltages of 100 or more are easily obtained between point B and ground—depending on the turns ratio of the if transformer secondary. The audio "ripple" component of the dc output is very large in amplitude, often exceeding 35 volts peak to peak, more than sufficient audio drive for a conventional output tube such as the 6AQ5, 6V6, etc. Normally, diodes do not amplify, but the action of this circuit is such that amplification seems to be taking place. Actually, most of the output developed is that which is usually wasted.

FM–AM detector

By substituting an rf transistor for D1 and a 1N34-A diode for D2, this circuit becomes an excellent FM detector. See Fig. 3 for details.[2] By inserting a limiting circuit ahead of the integrator, with provisions for switching in and out, the circuit detects AM or FM "at the flick of a switch." It is not very adaptable to conventional FM reception with vacuum-tube diodes. However, as an AM detector, the vacuum-tube version is exceptionally immune to QRM—noise—and has proved to be an ideal detector for converting or repairing old communications type receivers. END

*Chief engineer, Japan Electronic Trading Co., Tokyo, Japan.

[1] John Markus and Vin Veluff, Editors, "Stabilized Negative Impedances," *Electronics For Communication Engineers*, McGraw-Hill.

[2] P. L. Burton and F. Willis, "Unusual Transistor Circuits," *Wireless World*, March 1958.

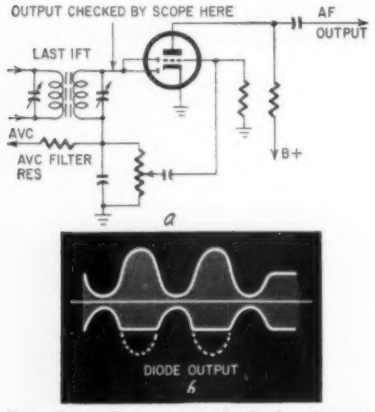


Fig. 1-a—Conventional diode detector circuit. Dc flows in if transformer's secondary, upsetting circuit Q; b—waveform showing how conventional diode conducts during more than 50% of rf cycle, generating unwanted distortion.

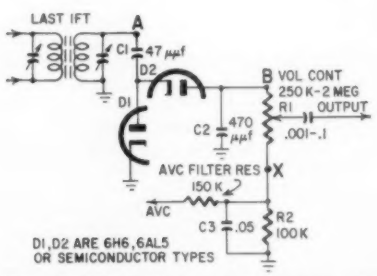


Fig. 2—Diode integrator–detector circuit. Diodes may be 6AL5, 6H6 or semiconductor units such as 1N35's.

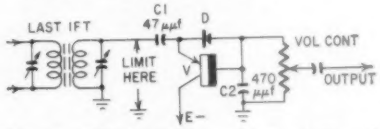
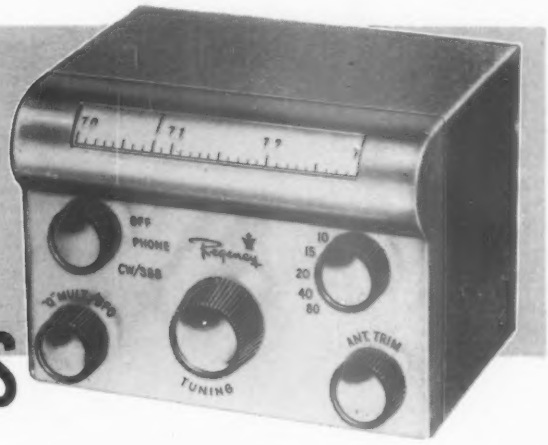


Fig. 3—FM detector version of Fig. 2 circuit. Using transistor instead of diode permits better discrimination of FM. Pair of back-to-back diodes inserted at "Limit Here" eliminates unwanted AM component from output. Switching out diode limeters converts detector back to AM operation.

TRANSISTOR CONVERTER hauls in HAM BANDS

Two-transistor unit puts the ham bands, including SSB transmission, on any home, auto or portable AM radio



By ROBERT F. SCOTT
TECHNICAL EDITOR

THE Regency ATC-1 all-transistor converter is designed for use with any home, auto or portable broadcast receiver to receive AM, SSB and CW signals in the 80-, 40-, 20-, 15- and 10-meter amateur bands. It is extremely compact—3¼ x 4¾ x 4-1/16 inches—and weighs only 30 ounces. A maximum of 600 μa is drawn from its three penlight cells so useful operating time approaches battery shelf life.

Each amateur band covers the full length of the slide-rule drum dial. The converter features a Q multiplier for high selectivity, bfo for CW and SSB reception and a clamp diode to prevent overloading or transistor damage by strong signals from nearby rigs.

The converter is inserted in series with the lead-in between the antenna and the set's antenna post. When turned off, the converter is bypassed and the antenna switched to the receiver.

How it works

The circuit of the ATC-1 is shown in Fig. 1. It is a superheterodyne unit with its output normally adjusted to 1230 kc. This frequency was selected so the receiver's oscillator would not produce harmonics falling in any amateur band. The heterodyne converter (V1) is an SB-100 surface-barrier transistor. The oscillator circuit operates on fundamentals on the three lower-frequency bands and on the second harmonic on 15 and 10 meters. The oscillator signal is on the high side of the signal frequency on 80, 40 and 20 meters and on the low side for 15 and 10 meters. Second-harmonic operation on the two higher-frequency bands gives more reliable oscillator operation and minimizes oscillator pulling.

The SB-100 is connected as an autodyne converter which combines the functions of local oscillator, mixer and if amplifier. The oscillator is a common-base type with feedback from the tickler coil in the collector circuit to the tuned circuit feeding the emitter. Oscillations are sustained at the oscillator transformer's frequency as set by C8-b. The base is effectively grounded for rf through the 30-μμf blocking capacitor (C12) and the tuned secondary of the antenna transformer.

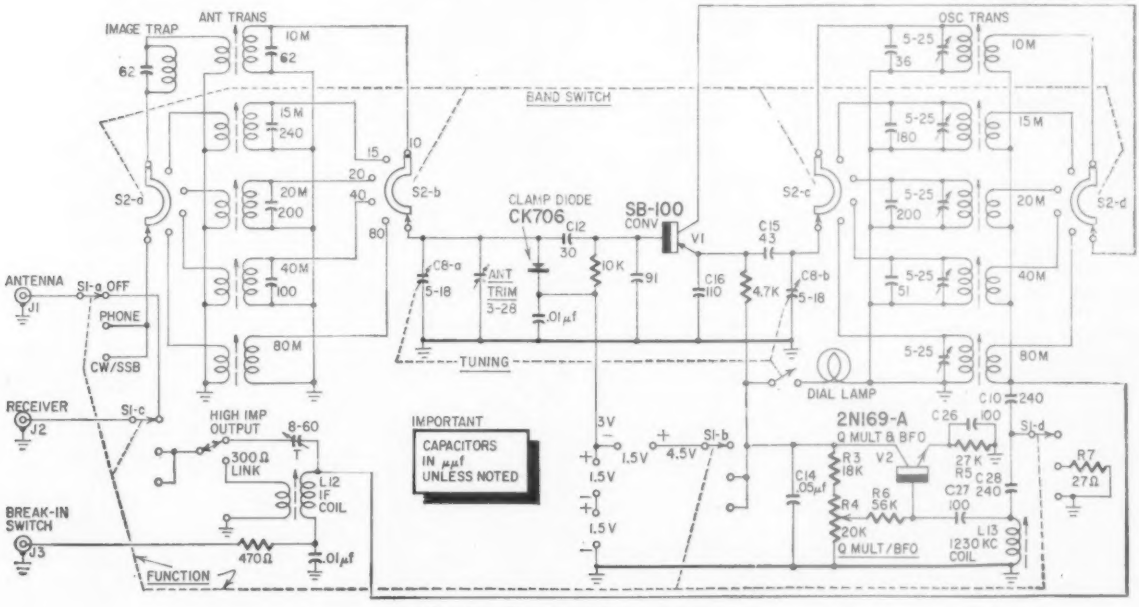
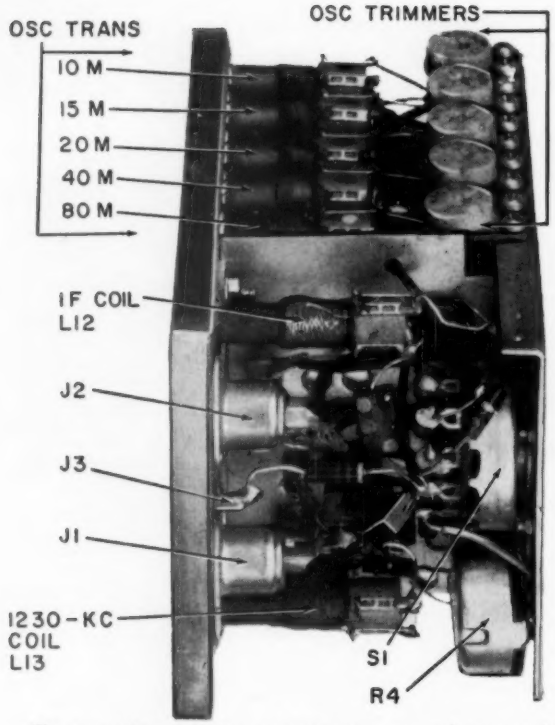
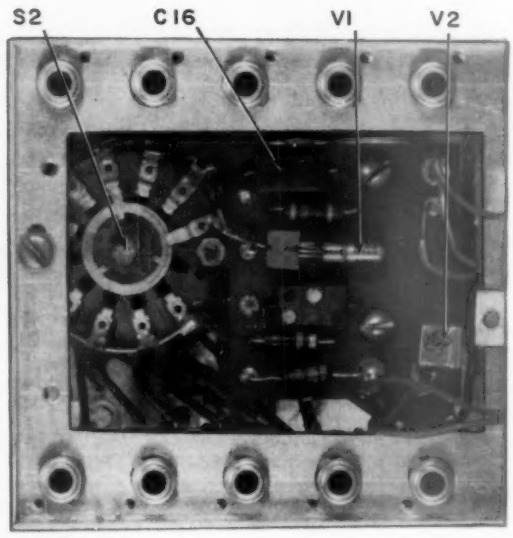


Fig. 1—Circuit of the converter.



Top-chassis view of the two-transistor unit.

The converter chassis seen from below.



The converter operates as a common-emitter arrangement. The antenna is connected to the primary of the antenna transformer selected by S2 and the desired signal is tuned in by C8-a across the secondary. The incoming signal is applied to the base of the transistor which is biased for non-linear operation. The emitter is effectively grounded by C16 and by C15 and the tuned winding of the oscillator transformer in series. The incoming signal on the base mixes with the oscillator signal on the emitter to produce a 1230-kc if signal across if coil L12 in the collector circuit. This if signal is fed to a high-impedance receiver antenna input circuit through a trimmer capacitor or to a low-impedance input circuit through a 300-ohm link winding.

The selectivity of the average converter–receiver combination is restricted to that of the receiver's front-end and if circuits. The average broadcast receiver is not selective enough for good performance on the crowded amateur bands so adequate selectivity has been built into the ATC-1 converter. This is done by providing a 1230-kc if with an exceptionally high Q.

As in any passive tuned circuit, the Q of if coil L12 is $R/\omega L$, where R is the equivalent circuit resistance *paralleled* across the tuned network and ω is $2\pi f$. The selectivity of the circuit varies inversely as R. Thus, selectivity and circuit Q approach infinity as R increases.

The Q multiplier

The ATC-1 uses a circuit called a *Q multiplier* to give the converter–receiver combination selectivity approaching that of a good communications receiver with a crystal or equivalent filter. Q multiplication is obtained by shunting the 1230-kc if coil with a regenerative circuit that develops a *negative* resistance (R_n). The effective resistance (R_{eff}) of the tuned circuit is then $R(-R_n)/R + (-R_n)$ or $R \times R_n/R_n - R$. Since R_{eff} is greater than R, the Q of the circuit is multiplied by the ratio of these two resistances. As R_n approaches R, circuit amplification increases and bandwidth decreases. When R_n exceeds R, the circuit oscillates.

The 2N169-A is connected in a basic Colpitts oscillator circuit with the emitter returned to the midpoint of a capacitive voltage divider consisting of C26 in series with the base–emitter capacitance. Fig. 2 shows the similarity between the circuit of the 2N169-A and a vacuum-tube Colpitts oscillator. The circuit inductance is L13, the 1230-kc bfo and Q multiplier coil. The gain of the circuit, and thus the amount of regeneration, is controlled by R4, which varies the base bias. This regenerative network is coupled to if coil L12. Emitter resistor R5 is used in place of the cathode choke in the vacuum-tube circuit to improve stability.

When the FUNCTION switch is in the CW/SSB position, C28, the tuning capacitor for L13, and L12's tuning capacitor (C10) are both grounded by S1-d. The Q MULT/BFO (regeneration) control is advanced just beyond the point where V2 starts to oscillate when receiving CW signals. On SSB signals, the regeneration control is advanced further to increase the output of V2 and provide the optimum level for exalted-carrier

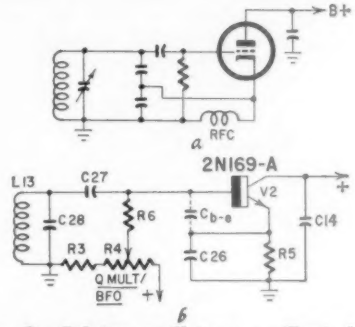


Fig. 2—Colpitts oscillators: a—Typical vacuum-tube unit. b—Transistor circuit used in the converter.

type reception. Stray coupling between L12 and L13 provides sufficient bfo injection voltage for CW and SSB.

When the switch is thrown to PHONE, R7 is inserted between ground and the junction of C10 and C28. L12 and L13, linked solely by stray capacitive and inductive coupling for CW and SSB, are now coupled by their collective currents flowing through R7. This provides a degree of coupling between the Q multiplier and if circuits and reduces the Q of each slightly to prevent excessive sideband cutting on AM signals. R4 is adjusted so the Q multiplier is just on the verge of oscillation for maximum gain and selectivity.

The additional coupling provided by R7 decreases the bandwidth of the 1230-kc if circuit and increases its gain over a narrow band of frequencies. Any signal falling on the peak of the narrowed passband is amplified much more than one falling down on the

RADIO, TV and the USSR

By LARRY STECKLER
ASSOCIATE EDITOR

THE most startling thing about the electronics section of the Soviet Exhibition at the New York Coliseum was that everything looked vaguely familiar. All the TV's, radios, record players and even stereo equipment looked like US-made (or European imports) that had been twisted slightly. (Even the Russians admit that their color TV system follows RCA's.)

Radio

Radio receivers range from the very simple to the extremely complex, but all cover at least two bands, and some cover as many as six or seven with electronic bandspread over important sections. Almost all cover the European FM band. Units come in all sizes and shapes, from the small 4-tube plastic-cased table model to the complicated console multi-band receiver which has a distinct likeness to many of the European imports seen in the US.

While exciting features are rare, one line of sets has a remote control worthy of special note. It connects to the set by way of a long thumb-thick cable. The remote unit looks like a miniature replica of the set's front panel and provides remote control of almost all receiver conditions and functions. The photo shows the remote-control unit in front of the set it controls.

The same receiver has an automatic station seeker. The operator simply presses a button—on the receiver or the remote control—and this mutes the set while it tunes to the next active station, stops and resumes playing. The remote control includes pushbutton band selection, bass and treble controls, on–off, and automatic and manual tuning. The system is apparently similar to that used in US auto radios.

The Festival, a multi-band radio receiver with its unusual remote-control unit.

A switch on the receiver itself is used to select the best antenna for the band being listened to.

Auto radios, in both tube and transistor versions were on display, and there were several transistor portables, one powered by a bank of solar cells built into its carrying handle. Some short-range communications gear designed for farmhouse to farmer-in-the-field use was also shown, but seemed rather bulky and complicated.

Television

All Russian TV sets incorporate printed circuitry, and one type of flyback transformer serves for all receivers. It is, in some undisclosed manner, easily adjusted and produces between 14 and 17 kv, depending on its setting. Also, many sets have pushbutton channel selection, a feature which US manufacturers discovered leads to excessive cost and servicing problems. The video if falls between 35 and 39 mc with a bandwidth of no less than 4.5 mc in 14-inch receivers and 6 mc in the 21-inch sets. While the 12 channels used correspond roughly to US channels, they are not the same. Each one is wider, 8 mc, and they all fall between 49.75 and 229.75 megacycles. Uhf is not used for television in Russia today nor are any uhf stations anticipated.

The Russian system uses 625 lines in its TV picture to work in with its 50-cycle line voltage and vertical sweep, making it compatible with Western European standards except for the difference in channel width and sound-carrier separation.

The Soviet TV receiver comes in three screen sizes—14, 17 and 21 inches. Anything larger calls for a projection set. The 14-inch models are the least expensive and the lowest in quality of the line. They have from 12 to 15 tubes and 4 to 6 diodes. Intercarrier receivers, they use a 6.5-mc sound if. They have either one or two small speakers, usually two.

The 17-inch version is a somewhat better set. It usually runs from 14 to 18 tubes and 5 to 8 diodes (4 of these are in the power supply). It is also an intercarrier set. Some models have a better speaker system than the less expensive 14-inch models.

The 21-inch receivers are the deluxe units. They may have as many as 21 tubes and 14 diodes and include an FM receiver, record player and power amplifier. They have split sound, which calls for a separate sound if strip. As many as seven speakers may be incorporated in their sound system, and some models use two audio amplifiers, one for the high frequencies and the other for the lows. Each amplifier feeds a set of speakers—in opposite ends of the cabinet—producing a quasi-stereo effect. Some sets also incorporate an FM receiver. The TV section is turned off and the separate sound section is used along with the receiver's tuner to pick up FM broadcasts in the 67.5- to 73-mc band.

The Soviet's transistor TV is still in the experimental stage, but some units were on display. They have a 10-inch screen and, like their big brothers, use printed circuitry. It takes 30 transistors and an undisclosed number of crystal diodes to put a picture on its screen. The set can be powered by a 12-volt rechargeable battery or by using a power pack off the ac line. Power consumption is 13 watts.

Hi-fi units, record players and tape machines follow US standards in respect to speeds and recording systems. The only way to sum it up is that some of the equipment seen at the show would look awfully good in anyone's living room. Of course, there is no way to tell whether these units are mass-produced or hand-built as there are no published figures. But compare these 1959 statistics:

	TV Sets in Use	*TV Stations in Use*
United States	51,000,000	548
Soviet Union	2,600,000	77

END

Transistor Converter

(Continued)

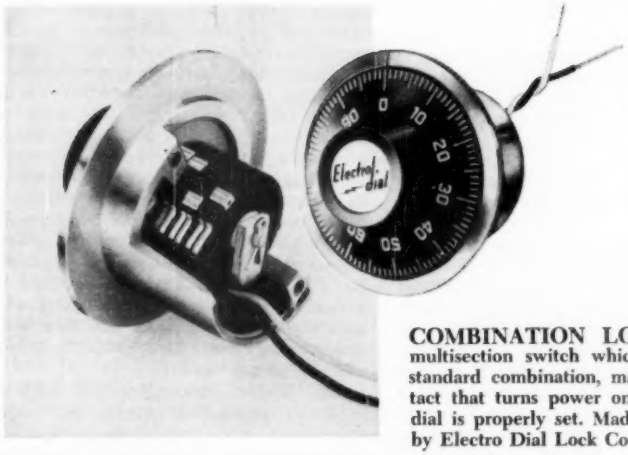
slope of the response curve. Thus, the overall selectivity of the converter–receiver combination is considerably better than that of many general-purpose shortwave receivers or the converter–receiver combinations generally used for amateur mobile work.

The dial lamp is controlled by a momentary type switch closed by pushing in on the tuning knob. This increases battery life by minimizing the use of a dial lamp that draws much more current than the transistors.

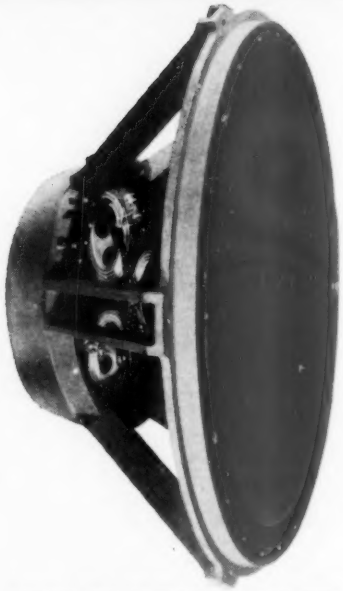
A BREAK-IN SWITCH jack in series between the SB-100's collector and ground facilitates break-in operation when the ATC-1 is used for amateur communications. A shielded single-conductor cable with a phono type plug on one end is connected across normally closed contacts on the transmitter's send–receive relay. The relay contacts open the collector return lead and disable the converter when transmitting. A shorted phono plug in J3 completes the circuit when break-in operation is not used. END

what's new?

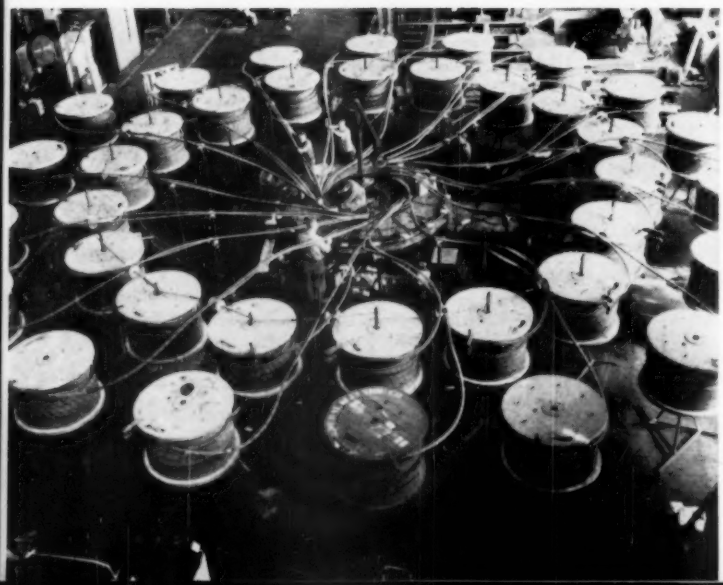
SHIP THAT NEVER GOES TO SEA is land-based replica of navigational section of submarine at Sperry's Ashore Polaris Navigation Center on Long Island, N.Y. Night picture shows sail (conning tower) structure, with a glimpse of the submarine body through the windows. This body contains complete Polaris navigational equipment, exactly as used on submarines; periscope atop sail is used to take positions by astronomical observation. Will be used to study problems in inertial-astronomical navigation and installation of equipment on submarines; later for training purposes.



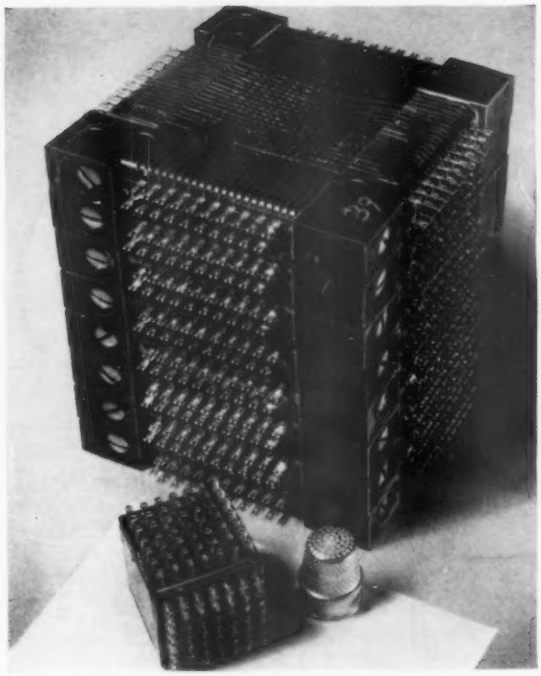
COMBINATION LOCK is rotary multisection switch which operates like standard combination, makes series contact that turns power on when Electro-dial is properly set. Made in Hollywood by Electro Dial Lock Co.



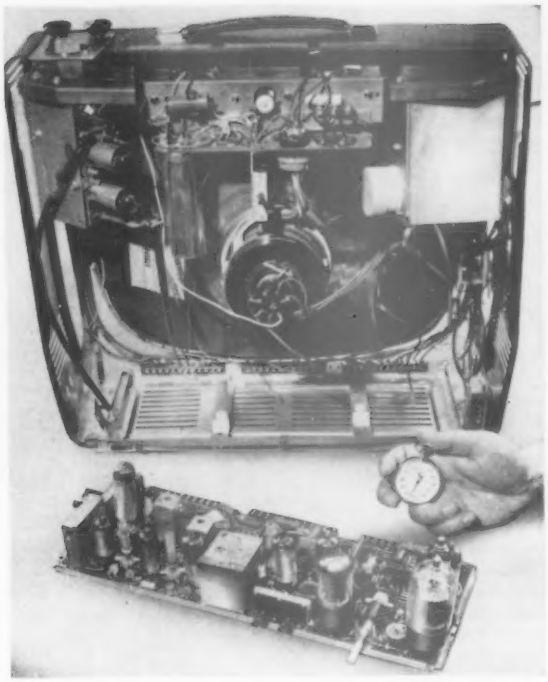
MASSIVE 32-INCH SPEAKER has three voice coils driving cone in parallel. Its three magnets total over 14 lbs. Monarch International, Hollywood, supplies this driver, which is two inches larger in diameter than the big high-fidelity speaker pictured in August RADIO-ELECTRONICS (p. 54).



BIGGEST COIL-WINDING job is to result in a monster coil which will stand 5 feet high, weigh 60 tons, contain 6 miles of tape-wound copper bar. Current will be about *1,000,000* amperes, creating magnetic clamping forces near 6,000 tons. Believed to be the biggest coil ever built, it will be used to create a spark discharge to heat air for supersonic wind tunnel. Being built by G-E for the Army Engineers, Tullahoma, Tenn.



MINIATURE MEMORY STACK saves space in big computers. Small stack of ferrite cores (note thimble) has only 96 connections, yet stores over 2,000 pieces of information indefinitely, as much as larger stack. Developed by General Ceramics Corp., Keasbey, N. J.



EASY-TO-SERVICE chassis of the new Motorola TV set is connected in circuit with spring clip contacts, can be removed for servicing in 33 seconds. The strip containing contacts can also be taken out and set put in operation with chassis on edge, easily accessible for servicing. Color-coded conductors on printed-circuit board make circuit tracing quicker and simpler.

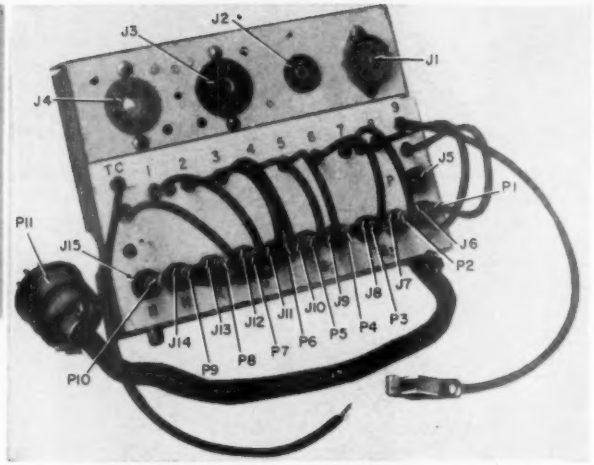
NEW RECHARGEABLE flashlight battery plugs into the ac line overnight to restore its original 2.5 volts (1.25 volts per cell). Made by Sonotone, the sintered-plate nickel-cadmium cells were originally developed for military use in missiles and jet aircraft, have recently been adapted for industrial and home use. Screwing cap on battery switches it from "charge" at 117 volts to "discharge" at 2.5 volts.

SUNMOTOR (2 volts at 200 ma) drives fan from silicon photocell. The little device was constructed by Dr. Bruno Lange of Berlin on his 25th anniversary as a photoelectric cell manufacturer. The motor runs even on light from ordinary household bulbs. Efficiency is about 10%.

new LIFE for your TUBE TESTER

Simple adapter brings the old tube checker up to date

By LEO L. BOWMAN



Patch-cord arrangement on adapter makes it possible to test all types of receiving tubes with octal, loctal, 9- or 7-pin miniature bases.

WITH an ever-growing list of new, newer and newest receiving tubes, the radio–TV technician's tube tester tends to become obsolete very rapidly. In only a year or two, the technician discovers that his tester will not check many of the tubes possible with the new models.

That is exactly the position I found myself in a while ago, so I decided to do something about it. I could buy a cheap tester each year or two and have an instrument I couldn't trust, or I could buy one of the better instruments at a much higher cost. Neither possibility appealed to me.

After some thinking and experimenting, I came up with the adapter shown in the diagram and photos. With this unit I can test any tube, so long as it has an octal, loctal, 7-pin or 9-pin miniature base. This covers all new types; my old tester will handle all others. [The loctal socket can be left out of the adapter if your tube checker has one. It is doubtful that any new loctal types will be manufactured.—*Editor*]

I built the unit into a small chassis —1 x 4¾ x 6½ inches—so it would fit into the line-cord compartment of my tube tester. The photo shows the layout I used. Other technicians may have other needs, requiring a different layout. This is not a problem as no critical wiring is involved.

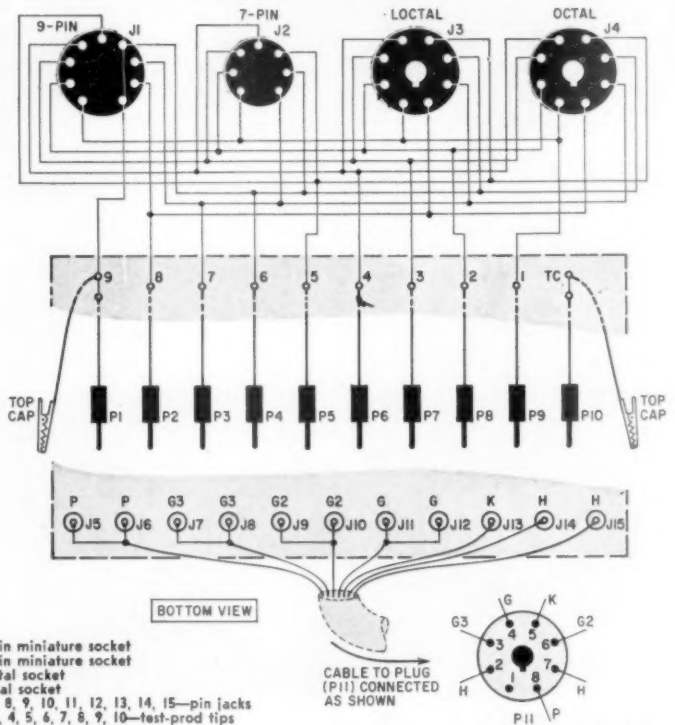
As you may expect, the adapter's plug is inserted into the octal socket of the tube tester. The cable connected to this plug goes to the adapter and is connected to the various pin jacks. My unit is set up so the adapter plug is considered as a 6SK7—the tube tester's switches are set up for a 6SK7.

The pin jacks are all connected to their respective tube-socket pins—lead 1 goes to pin 1, lead 2 to pin 2 and so on. Two plate and grid caps are also provided—one connects to the pin-9 terminal, the other is marked TC for top cap.

To use the adapter, plug it into the tube tester and set the tester's switches for a 6SK7. Then set filament voltage for the tube you are going to test. Set other tube-checker controls as if you were testing a similar type tube that the checker can handle. Next plug the tube into the adapter and set up the patch cords for the tube you are checking. If pin 1 is the plate, patch cord 1 is connected to the jack marked P. Make a note of the settings and you'll be all set the next time you run into this tube.

It might be wise to test new known-good tubes before using the tester to check tubes that may be bad. In this way you will know where to set the controls to get a reading in the middle of the GOOD range. When doing this, connect a milliameter in the plate circuit of the adapter and set the shunt controls to pass the rated plate current of the tube.

The only point to remember is that the switching arrangement of your tube tester should be set for a 6SK7 whenever you use the adapter. Just change heater voltage and shunt settings of the instrument to conform to the tube type being tested. END



J1—9-pin miniature socket
J2—7-pin miniature socket
J3—loctal socket
J4—octal socket
J5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15—pin jacks
P1, 2, 3, 4, 5, 6, 7, 8, 9, 10—test-prod tips
P11—octal plug
Chassis, 1 x 4¾ x 6½ inches
Alligator clips (2)

Circuit of the tube-tester adapter.

Test instrument for the audiophile covers 3 mv to 300 volts and has a frequency span of 15 to 20,000 cycles

Audio Millivoltmeter

By MARTIN De FRANCE

BASICALLY, a millivoltmeter consists of a high-gain amplifier followed by a voltmeter. However, things are not quite as simple as the definition might lead one to believe. The precision, linearity and stability of the instrument are very important factors and have been duly taken into account in the accompanying circuit, by H. Schreiber and published in *Toute la Radio* (September, 1957).

The instrument measures from 3 mv to 300 volts, over the frequency range from 15–200,000 cycles. The critical voltages are stabilized. A 10% variation in the line voltage results in a 1% to 3% variation in gain, mainly because of the variation in the voltage of the heater.

Fig. 1 shows a cathode-follower probe containing a 6AB4 which is used for all voltages up to 10 volts—the cathode follower is linear up to 15 volts. Larger voltages could be measured with an ordinary voltmeter but, as an added convenience, three extra ranges have been added: 30, 100 and 300 volts, with direct input. A resistance divider is used to cover 3 mv to 300 volts in 11 ranges.

The amplifier uses two high-transconductance pentodes (an EF80/6BX6 and ½ of a 6U8) to provide a total gain of about 1,000. The gain is stabilized and the bandwidth increased by using cathode feedback with a small shunting capacitor to increase gain at high frequencies.

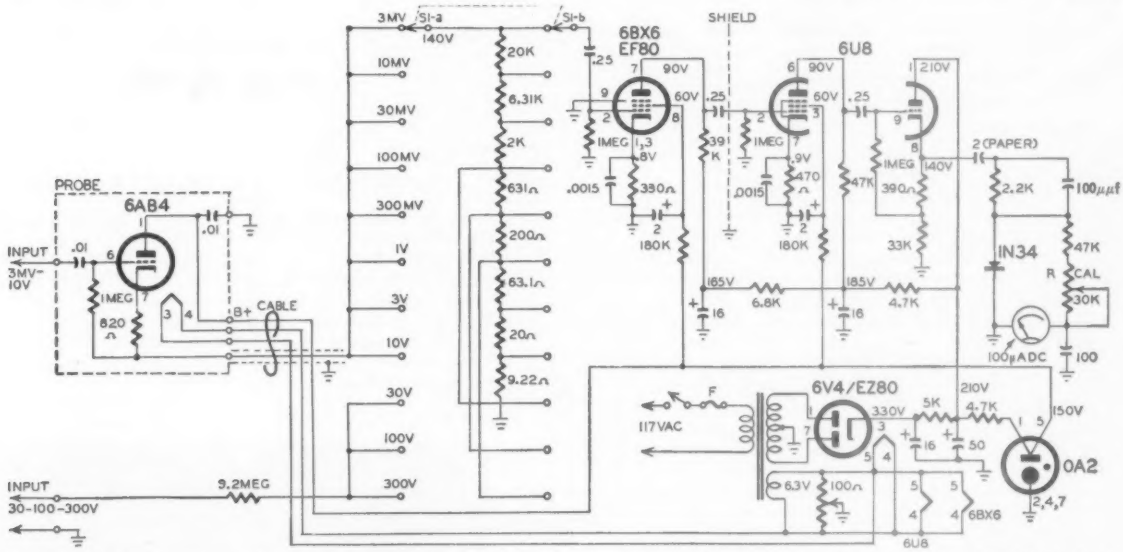


Fig. 1—The millivoltmeter and its cathode-follower probe. The power transformer secondary was rated at 580 volts ct. A 600-volt ct secondary will probably work well.

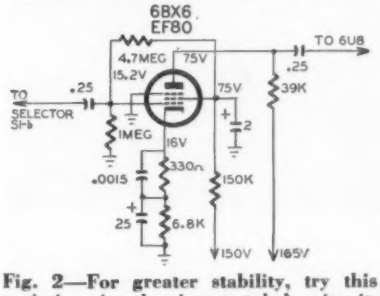


Fig. 2—For greater stability, try this variation in the input tube's circuit.

Without the capacitors, response is linear up to 50,000 cycles. With the capacitors, it is linear up to 200,000 cycles.

A clever trick has been used to eliminate any instability due to the second amplifier's plate current. This stage drives a cathode follower whose load resistance is such that total anode current for the amplifier and cathode follower remains constant.

The cathode follower provides a low-impedance source to drive the meter through a crystal rectifier. A high-frequency compensating R-C circuit has been added, and potentiometer R allows for calibration.

The ranges on the selector switch are approximate. Actually, they are not quite in a 1–3–10 ratio. The ratio is constant and equal to $\sqrt{10}$—that is 3.16—between any two adjacent ranges.

The power supply uses a transformer and a standard rectifier (EZ80/6V4). A good filter is provided, and a regulator tube stabilizes the B-plus to the input cathode follower and the screens. The large capacitor across the meter eliminates short-term fluctuations. The normal voltages have been indicated on the diagram.

If better stabilization is wanted, a variant of the original circuit can be used (Fig. 2). It uses heavy dc feedback to stabilize the plate current and the quiescent working point. The same technique is commonly used for temperature compensation with transistors.

A hum-balancing potentiometer is used to ground the heater circuit. A small shielding partition is recommended to avoid unwanted coupling between the two amplifying stages. The resistors in the input voltage divider should be precision types. END

EVERYTHING A CLOCK-RADIO CAN OFFER . . . AND PORTABLE TOO!

- Completely portable, all-transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble

HEATHKIT TCR-1
$45.95

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuit . . . then slash the price at least in half, and you have the new Heathkit "Your Cue" Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment in and out-of-doors. It can also be used with the Heathkit Transistor Intercom system, opposite page, to provide music or a "selective alarm" system for one or more rooms covered by the intercom system.

An "Alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. All controls are conveniently located and simple to operate. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music, or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system. At all times crystal-clear portable radio entertainment is yours at the flick of a switch.

The modern 6-transistor circuit features prealigned IF's for ease of assembly. A tuned RF stage and double tuned input to the IF stage assure top performance. The built-in rod-type antenna pulls in far-off stations with outstanding clarity while a large 4" x 6" speaker provides tonal reproduction of unusual quality.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used with reduced battery life.

The handsome two-tone cabinet, measuring only 3½" H. x 8" W. x 7½" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking, or camping.

Wherever you are, you'll find "Your Cue" your constant companion. Shpg. Wt. 5 lbs.

HEATH COMPANY/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

New Transistor Intercom Kit

TALK WITH ANY OR ALL FIVE STATIONS WITH YOUR OWN INTERCOM SYSTEM

- Battery Power Permits Placement Anywhere
- Versatile Unit has Many Important Uses
- Complete Privacy of Conversations Assured

TRANSISTOR INTERCOM KIT (XI-1 and XIR-1)

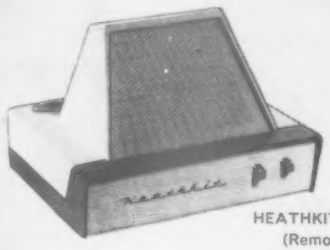
A flexible, versatile transistor intercom, has been developed by Heath engineers to enable you to set up your own communications system at an unbelievably low price.

Consisting of a master unit (XI-1) and up to five remote stations (XIR-1), the system is designed for any remote unit to call the master, for any remote station to call any other remote station, or for the master unit to call any single remote unit or any combination of remote units. Complete privacy is assured, since a call to a remote station cannot be interrupted or listened to while the remote unit is in operation unless switched in by the master unit. Used with clock-radio, opposite page, it can serve as a music or "selective alarm" system.

Transistor circuitry means long life, instant operation and minimum battery drain. Eight ordinary, inexpensive "C" flashlight batteries will run a unit for up to 300 hours of normal "on" time. Circuitry is especially designed for crisp, clear intelligible communication and the instant operation feature allows tuning of the units off between calls, extending battery life. Use of battery power does away with power cords, allowing each unit to be placed where most convenient. Only two wires are required between the master unit and each remote station. Beautifully styled, the Heathkit Intercom presents a new approach in design. Both master and remote stations have two-piece cases in ivory and turquoise for a rich, quality appearance. Batteries not included. Shpg. Wt. 6 lbs.

HEATHKIT XI-1 (Master)

$27.95



HEATHKIT XIR-1 (Remote)

$6.95

Shpg. Wt. 4 lbs.

AC POWER SUPPLY (XP-1)

A permanent power supply for 24-hour operation of the XI-1 Intercom on household current. Converts 110 V. AC to well filtered 12-volt DC output, eliminating the need for batteries. Power supply is small, compact and fits in space normally occupied by batteries.

HEATHKIT XP-1 ..... $9.95

NEW IMPROVED DESIGN

STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Get the SP-2A Stereo Preamp kit now, or the SP-1A monophonic version which you can easily convert to stereo whenever you choose by assembling the second channel (C-SP-1A) and plugging it into your SP-1A.

The SP-2A permits stereo, two channel mixing, or either channel monophonic use, and includes a remote balance control.

Six inputs (12 in the stereo version) accommodate tape, magnetic phono and microphone, plus three separate high level inputs. Level controls provided on "mag. phono" and high level inputs. Switch selects NARTB equalization for tape head input, and RIAA, LP or 78 RPM compensation for mag. phono input

HEATHKIT SP-1A (monophonic) Shpg. Wt. 13 lbs. $37.95

HEATHKIT C-SP-1A (not shown) (converts SP-1A to SP-2A) Shpg. Wt. 4 lbs. $21.95

New

HEATHKIT SP-2A (stereo) Shpg. Wt. 15 lbs.

$56.95

$5.70 down. $6.00 mo.

THE WORLD'S BIGGEST BARGAIN IN A HI-FI AMPLIFIER

New

55 WATT HI-FI AMPLIFIER KIT (W-7A)

Utilizing advanced design in components and tubes to achieve unprecedented performance with fewer parts, Heathkit has produced the world's first and only "dollar-a-watt" genuine high fidelity amplifier. Meeting full 55-watt hi-fi rating and 50-watt professional standards, the new improved W-7A provides a comfortable margin of distortion-free power for any high fidelity application.

The sleek, modern styling of this unit allows unobtrusive installation anywhere in the home. The clean, open layout of chassis and precut, cabled wiring harness makes the W-7A extremely easy to assemble. Shpg. Wt. 28 lbs.

HEATHKIT W-7A

$54.95

SPECIFICATIONS—Power output: Hi-Fi rating, 55 watts; Professional rating, 50 watts. **Power response:** ±1 db from 20 cps to 20 kc at 55 watts output. **Total harmonic distortion:** Less than 2% from 30 cps to 15 kc at 55 watts output. **Intermodulation distortion:** Less than 1% at 62 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 80 db below 55 watts, unweighted. **Damping factor:** Switch on front panel for selecting either maximum (20:1) or unity (1:1). **Output impedances:** 4, 8 and 16 ohms and 70-volt line. **Power requirements:** 117 volts, 50/60 cycles, 90-160 watts. **Dimensions:** 8½" D. x 6¼" H. x 15" W.

New HEATHKIT

Stereo Amplifiers

HEATHKIT SA-1

$79.95

FOR THE FINEST IN STEREO...

"DELUXE" 14-WATT STEREO AMPLIFIER KIT (SA-1)

Offering every deluxe feature imaginable in a stereo amplifier, the SA-1 also provides 14 watts per stereo channel and 28 watts total monophonic power. Separate bass and treble tone controls for each stereo channel permit you to adjust sound reproduction to suit your taste. A 4-position function switch (stereo, stereo reverse, channel A, channel B) makes it possible for any monophonic source to be fed into either channel individually or to both channels simultaneously. By adjusting the individual channels, you can even impart a pseudo-stereo effect to monophonic program material. A special "dimension" control eliminates the "hole-in-the-middle" effect sometimes produced through varying stereo recording practices. The SA-1 features five switch-selected inputs for each channel; magnetic phono, tape head, and three auxiliary inputs for high level sources. A special sixth position on the selector switch permits use of a monophonic magnetic phono cartridge, through either or both channels. Magnetic phono inputs are RIAA equalized; tape head input is NARTB equalized. All inputs, except that for the "tape head" feature individual level controls. Ganged volume controls permit adjusting the gain of both channels simultaneously, and a separate balance control allows precise channel balancing. Internal amplifier controls for each channel are also provided. Beautifully styled with vinyl-clad steel cover in leather-like texture of black and inlaid gold design. Shpg. Wt. 30 lbs.

New

HEATHKIT SA-2

$52.95

YOUR BEST DOLLAR VALUE IN STEREO...

14-WATT STEREO AMPLIFIER KIT (SA-2)

Complete control of your entire stereo system is at your fingertips with this versatile Stereo Amplifier-Preamplifier combination. Providing 14 watts per stereo channel, or 28 watts total monophonic, the SA-2 offers every modern feature required in a master stereo control center, and at a price to please the budget minded. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%; 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched, 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4½" H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

New

HEATHKIT SA-3

$29.95

GO STEREO FOR $29.95

ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure, undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste.

You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Larger than life-size diagrams show you exactly what each part looks like, where it goes, and how it is installed.

The amplifier is tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price! Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ±1 db from 50 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%; 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 65 db below full output. **Controls:** dual clutched volume; ganged treble, ganged bass; 7-position selector; speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12½" W. x 6¾" D. x 3¼" H.

New HEATHKIT® Amplifiers & Tuners

A NEW AMPLIFIER AND PREAMP UNIT PRICED WELL WITHIN ANY BUDGET

14-WATT HI-FI AMPLIFIER KIT (EA-3)

This thrilling successor to the famous Heathkit EA-2 is one of the finest investments anyone can make in top quality high fidelity equipment. It delivers a full 14 watts of hi-fi rated power and easily meets professional standards as a 12-watt amplifier.

Rich, full range sound reproduction and low noise and distortion are achieved through careful design using the latest developments in the audio science. Miniature tubes are used throughout, including EL-84 output tubes in a push-pull output circuit with a special-design output transformer. The built-in preamplifier has three separate switch-selected inputs for magnetic phono, crystal phono or tape, and AM-FM tuner. RIAA equalization is featured on the magnetic phono input. Shpg. Wt. 15 lbs.

NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: 14 watts, HI-Fi; 12 watts, Professional; 16 watts, Utility. **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HEATHKIT EA-3

$29.95

NEVER BEFORE HAS ANY HI-FI AMPLIFIER OFFERED SO MUCH AT SO LOW A PRICE

New

"UNIVERSAL" 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Meeting 14-watt "hi-fi" and 12-watt "professional" standards, the UA-2 lives up to its title "universal" performing with equal brilliance in the most demanding monophonic or stereophonic high fidelity systems. Its high quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Buy two for stereo. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: Hi-Fi rating, 14 watts; Professional rating, 12 watts. **Power response:** ±1 db from 20 cps to 20 kc at 17 watts output. **Total harmonic distortion:** Less than 2% from 20 cps to 20 kc at 14 watts output. **Intermodulation distortion:** Less than 1% at 14 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 73 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms. **Damping factor:** Switched for unity or maximum; maximum damping factor 15:1. **Input voltage for 14 watt output:** .7 volts. **Power requirements:** 117 volts 50/60 cycles, 55 watts. **Dimensions:** 10" W. x 6½" D. x 4¾" H.

HEATHKIT UA-2

$22.95

MORE STATIONS AND TRUE FM QUALITY ARE YOURS WITH THIS FINE TUNER KIT

New

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned intermediate stage transformers and assembled tuning unit makes construction simple—guarantees top performance. Flywheel tuning and new soft, evenly-lighted dial scale provide smooth, effortless operation. Vinyl-covered case has black, simulated-leather texture with gold design and trim. Multiplex adapter output also provided. Shpg. Wt. 8 lbs.

SPECIFICATIONS—Tuning range: 88 to 108 mc. **Quieting sensitivity:** 2.5 uv for 20 db of quieting. **IF frequency:** 10.7 mc. **Image ratio:** 45 db. **AFC correction factor:** 75 kc per volt. **AM suppression:** 25 db. **Frequency response:** ±2 db 20 to 20,000 cps. **Harmonic distortion:** Less than 1.5%, 1100 uv, 400 cycles 100% modulation. **Intermodulation distortion:** Less than 1%, 60 cycles and 6 kc mixed 4:1 1100 uv, 30% modulation. **Antenna:** 300 ohms unbalanced. **Output impedance:** 600 ohms (cathode follower). **Output voltage:** nominal .5 volt (with 30% modulation, 20 uv signal). **Power requirements:** 105-125 volts 50/60 cycle AC at 25 watts. **Overall dimensions:** 4½" H. x 13¼" W. x 5½" D.

HEATHKIT FM-4

$34.95

HEATH COMPANY/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

New HEATHKIT Tape Recorders

- Choice of 3 Outstanding Models
- Compare With $350-$400 Machines
- Preassembled Tape Mechanism
- Choice of Monophonic or Stereo models
- Complete versatility
- Easy to assemble, easy to use

PROFESSIONAL QUALITY TAPE RECORDER KITS (TR-1 Series)

Enjoy the incomparable performance of these professional quality tape recorders at less than half the usual cost. These outstanding kits offer a combination of features found only in much higher priced professional equipment, generally selling for $350 to $400. Not the least of these special features is the handsome styling which characterizes the kits . . . a semi-gloss black panel is set off by a plastic escutcheon in soft gold, which is matched by black control knobs with gold inserts. The mechanical assembly, with fast forward and rewind functions, comes to you completely assembled and adjusted; you build only the tape amplifier. And, you'll find this very easy to accomplish, since the two circuit boards eliminate much of the wiring. Separate record and playback heads and amplifiers allow monitoring from tape while recording and a "pause" control permits instant starting and stopping of tape for accurate cueing and tape editing. A digit counter is provided for convenient selection of any particular recording. Push-pull knob provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch reduces possibility of accidental erasure of recorded tapes. Shpg. Wt. 30 lbs.

SPECIFICATIONS—Tape speed: 7.5" and 3.75" per second. **Maximum reel size:** 7". **Frequency response (record-playback):** ±2.5 db, 30 to 12,000 cps at 7.5 IPS; ±2.5 db, 30 to 6,500 cps at 3.75 IPS. **Harmonic distortion:** 1% or less at normal recording level; 3% or less at peak recording level. **Signal-to-noise ratio:** 50 db or better, referred to normal recording level. **Flutter and wow:** 0.3% RMS at 7.5 IPS; 0.35% RMS at 3.75 IPS. **Heads (3):** erase, record, and in-line stereo playback (TR-1C, monophonic playback). **Playback equalization:** NARTB curve, within ±2 db. **Inputs (2):** microphone and line. **Input impedance:** 1 megohm. **Model TR-1D & TR-1E outputs (2):** A and B stereo channels. **Model TR-1C output (1):** monophonic. **Output levels:** approximately 2 volts maximum. **Output impedance:** approximately 600 ohm (cathode followers). **Recording level indicator:** professional type db meter. **Bias erase frequency:** 60 kc. **Timing accuracy:** ±2%. **Power requirements:** 105-125 volts AC, 60 cycles, 35 watts. **Dimensions:** 15½" W. x 13½" D. Total height 10¼". **Mounting:** requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

MODEL TR-1C Monophonic Tape Deck: Monophonic Record and Playback. **$159.95** $16.00 DWN. $14.00 MO.

MODEL TR-1D Two Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 2-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

MODEL TR-1E Four Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 4-track Pre-recorded Stereo Tapes (stacked). **$179.95** $18.00 DWN. $16.00 MO.

MODEL C-TR-1C Conversion Kit: Converts TR-1C to TR-1D (see TR-1D description above). Shpg. Wt. 2 lbs. **$19.95**

MODEL C-TR-1D Conversion Kit: Converts TR-1D to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. **$14.95**

NOTE: To convert TR-1C to TR-1E, purchase both C-TR-1C and C-TR-1D conversion kits.

STEREO-MONO TAPE RECORDER KITS (TR-1A Series)

Here are the tape recorders the avid hi-fi fan will find most appealing! Their complete flexibility in installation and many functions make them our most versatile tape recorder kits. This outstanding tape recorder now can be purchased in any one of three versions. You can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and play back both stereo and monophonic programming, or the two-track monophonic record-playback version (TR-1A) and later convert to either two-track or four-track stereo record-playback models by purchasing the MK-4 or MK-5 conversion kits. The tape deck mechanism is extremely simple to assemble. Long, faithful service is assured by precision bearings and close machining tolerances that hold flutter and wow to less than 0.35%. Power is provided by a four-pole, fan-cooled induction motor. One lever controls all tape handling functions of forward, fast-forward or rewind modes of operation. The deck handles up to 7" tape reels at 7.5 or 3.75 IPS as determined by belt position. The TR-1A series decks may be mounted in either a vertical or horizontal position (mounting brackets included). The TE-1 Tape Electronics kits supplied feature NARTB equalization, separate record and playback gain controls and a safety interlock. Provision is made for mike or line inputs and recording level is indicated on a 6E5 "magic eye" tube. Two circuit boards simplify assembly.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-4 Tape Electronics kit. Shpg. Wt. 24 lbs. **$99.95** $10.00 DWN. $9.00 MO.

TR1A SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 50 to 12,000 cps; 3.75 IPS ±3 db 50 to 7,000 cps. **Signal-to-noise ratio:** better than 45 db below full output of 1.25 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

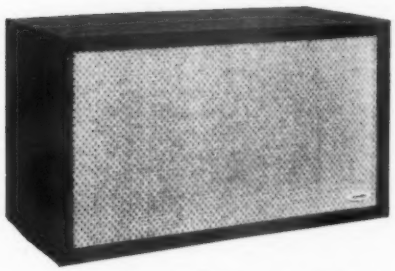
TR-1AH SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ± db 40 to 10,000 cps. **Signal-to-noise ratio:** 45 db below full output of 1 volt/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

TR-1AQ SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ±3 db 40 to 10,000 cps. **Signal-to-noise ratio:** 40 db below full output of .75 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase:** 60 kc (push-pull oscillator).

HEATH COMPANY/Benton Harbor, Mich. a subsidiary of Daystrom, Inc.

New "Acoustic Suspension" Hi-Fi Speaker System Kit



HEATHKIT AS-2U (unfinished)

$69.95

HEATHKIT AS-2M (mahogany) **$79.95**
HEATHKIT AS-2B (birch) **EACH**

NOW—FOR THE FIRST TIME —EXCLUSIVELY FROM HEATH

ACOUSTIC SUSPENSION HI-FI SPEAKER SYSTEM KIT (AS-2)

A revolutionary principle in speaker design, the Acoustic Research speaker has been universally accepted as one of the most praiseworthy speaker systems in the world of high fidelity sound reproduction. Heathkit is proud to be the sole kit licensee of this Acoustic Suspension principle from AR, Inc., and now offers for the first time this remarkable speaker system in money-saving, easy-to-build kit form.

The 10" Acoustic Suspension woofer delivers clean, clear extended-range bass response and outstanding high frequency distribution is provided by the specially designed "cross-fired" two-speaker tweeter assembly.

Another first in the Heathkit line is the availability of preassembled and prefinished cabinets. Cabinets are available in prefinished birch (blond) or mahogany, or in unfinished birch suitable for the finish of your choice. Kit assembly consists merely of mounting the speakers, wiring the simple cross-over network and filling the cabinet with the fiberglass included. Shpg. Wt. 32 lbs.

SPECIFICATIONS—Frequency response (at 10 watts input): ±5 db, 42 to 14,000 cps; 10 db down at 30 and 16,000 cps. **Harmonic distortion:** below 2% down to 50 cps, below 3% down to 40 cps at 10 watts input in corner room location. **Impedance:** 8 ohms. **Suggested amplifier power:** 20 watts minimum. **Suggested damping factor:** high (5:1 or greater). **Efficiency:** about 2%. **Distribution angle:** 90° in horizontal plane. **Dimensions:** 24" W. x 13½" H. x 11⅜" D.

New Test Equipment

HEATHKIT FMO-1 Price to be announced

AN INSTRUMENT LONG-AWAITED BY SERVICE TECHNICIANS EVERYWHERE!

HEATHKIT FM TEST OSCILLATOR KIT (FMO-1)

Here in one compact, easy-to-use instrument are provided all the test signals and sweep frequencies required for fast, easy alignment and troubleshooting of RF, IF and detector sections of FM tuners and receivers. An instrument unique in the test equipment field . . . being the only one of its type designed especially for FM service work.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc, 400-cycle audio. **Controls:** main frequency selector, modulation switch /concentric level control, marker oscillator switch /concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7⅞" H. x 4¾" W. x 4⅜" D.

HEATHKIT RF-1

$27.95

PREASSEMBLED AND ALIGNED BANDSWITCH/COIL ASSEMBLY

RF SIGNAL GENERATOR KIT (RF-1)

Moderately priced, and capable of precision performance the RF-1 provides highly accurate and stable RF signals for trouble-shooting and aligning RF and IF circuits of all kinds. Modulated or unmodulated RF output of at least 100,000 microvolts is available, controlled by both fixed-step and continuously variable controls. A built-in 400 cycle audio generator with 10-volt output provides internal modulation of RF signal and is available separately for audio tests. A preassembled bandswitch and coil assembly, aligned to factory precision standards, eliminates the need for special alignment equipment. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2%. **Output:** impedance, 50 ohms; voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30% depth; external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6½" W. x 9½" H. x 5" D.

New HEATHKIT Ham Radio Gear

HEATHKIT KS-1

$169.95

TOP POWER WITH ECONOMY AND SAFETY

KILOWATT POWER SUPPLY KIT (KS-1)

The KS-1 is designed as a companion to the "Chippewa" Linear Amplifier and is also suitable for supplying plate power to most other RF amplifiers in the medium to high power class. The KS-1 features an oil-filled, hermetically sealed plate transformer to minimize corona, a swinging choke in the filter circuit for good regulation, and a 60-second time delay relay to permit adequate heating of the mercury vapor rectifiers before application of plate voltage. All components are conservatively rated and well insulated for long life and dependable service. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifiers. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave, single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17¾" W. x 12" H. x 13" D.

HEATHKIT KL-1

$415.00

MOVE TO THE TOP IN TRANSMITTING POWER

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

The KL-1 operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4—400's) push the "Chippewa" to top performance levels while a centrifugal blower provides more than adequate cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meters): Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 60 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (28 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Input impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma screen current; 0 to 5000 volt plate voltage; 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube, (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19½" W. x 11⅞" H. x 16" D.

HEATHKIT XC-2

$36.95

2-METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2-meter band. May also be used with receivers tuning a 4 mc segment between the frequencies of 22 and 35 mc when appropriate crystal is used. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Noise figure: 4.5 db; 1 uv signal provides 20 db thermal noise quieting. **Sensitivity:** approx. .1 uv input will provide a signal better than 6 db over noise level. **Gain:** approx. 40 db. **Pass band:** essentially flat 144 to 148 mc; approx. 35 db down at 143 and 149 mc. **Image rejection:** better than 100 db (tunable). **Output impedance:** 50 to 75 ohms. **Input impedance:** 50 to 75 ohms; 300 ohms with balun. **Frequency:** input, 144 to 148 mc; output, 22 to 26 mc with crystal supplied. **Tubes:** 6AM4, 6BS8, 6EA8, 12AT7. **Crystal:** .005% 3rd overtone. **Power requirements:** 150 volts DC at 50 ma (dropping resistor supplied for 210 VDC RX-1 operation) 6.3 volts AC/DC at 1.375 amps. **Size:** 9" W. x 5½" H. x 4¾" D.

HEATHKIT UT-1

$28.95

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

This power supply is ideal for converting the Heathkit "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation; or may be used to provide necessary filament and plate voltage for a wide variety of amateur equipment. Features silicon diode rectifiers, high capacity filters for superior dynamic regulation, and line filtering to minimize TVI and reduce receiver line noise. On ICAS basis, provides 150 watts DC plus filament power for 6.3 volt or 12.6 volt filament applications (6.3 VAC., 8 amps. or 12.6 VAC., 4 amps.; 600 VCD., 250 ma or 600 VDC., 200 ma and 300 VDC., 100 ma). Less than 1% ripple; excellent regulation. Housed in attractive green and gray-green cabinet measuring 9" long, 4¾" wide, 6" high. Shpg. Wt. 15 lbs.

New Citizen's Band Transceiver

WIRED OR KIT FORM

HEATHKIT CB-1
$42.95
(kit model)

HEATHKIT W-CB-1
$60.95
(wired model)
$6.10 dwn., $6.00 mo.

Both models include transceiver, crystal, microphone and two special power cords.

- No Tests to Take—No Operator's License Required
- Any Citizen 18 or Older Can Have Own Station
- Hundreds of Business and Personal Uses

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

The Heathkit CB-1 Citizen's Band Transceiver is a compact radio transmitter and receiver combination designed to operate on the new 11-meter "Citizen's Band". No tests to take, no special knowledge or operator's license required . . . you need only fill out forms we supply, and mail them to FCC to apply for station license. Operates just like any short wave radio used by police and other communication services. Front panel switch selects both "transmit" and "receive". Two or more Heathkit Transceivers provide you with your own 2-way radiotelephone system for making necessary business and personal contacts with family, friends or associates. A Heathkit accessory power supply makes the CB-1 completely portable for use in cars, trucks, boats, etc., using 6 or 12 volt batteries. With appropriate accessory antenna, the CB-1 can be used for communicating between truck and office, home and automobile, boat and shore, farm-house and field . . . literally hundreds of useful applications. Comes complete with microphone, 2 power cords for mobile or fixed operation, station ID card, call letters, and crystal for one channel and FCC application form. Order power supply and antenna separately. Attractively styled in two-tone "mocha" and "beige". Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver type: Superregenerative detector w /rf stage. **Power input:** 5 watts maximum to plate of final RF amplifier (FCC requirement). **Transmitter frequency control:** Third overtone type quartz crystal operating within 0.005% of marked channel frequency between —20° and +130° F. **Modulation:** AM plate and screen modulation automatically limited to less than 100% (FCC requirements). **Power supply:** Internal 117 V, 50/60 cycles, AC (35 watts). For 6 V battery power, use Model VP-1-6 Vibrator Power Supply (6.5 amps); for 12 V battery power, use VP-1-12 (4 amps). **Total B+ requirements:** 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.8 amps, or 12.6 volts at 0.9 amps. **Power rectifier:** 2 silicon diodes in full wave voltage doubler circuit. **Microphone:** Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. **RF output impedance:** 50 ohms. **Speaker size:** 3½" (round). **Undistorted audio power output:** Approximately 1 watt. **Line cords:** Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. **Cabinet dimensions:** 8" H. x 6" D. x 9¾" W.

SPECIFY FREQUENCY CHOICE
(1st and 2nd choice)

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc	27.035 mc	27.115 mc	27.185 mc
26.975 mc	27.055 mc	27.125 mc	27.205 mc
26.985 mc	27.065 mc	27.135 mc	27.215 mc
27.005 mc	27.075 mc	27.155 mc	27.225 mc
27.015 mc	27.085 mc	27.165 mc	*27.255 mc
27.025 mc	27.105 mc	27.175 mc	

*This channel shared with Class C Radio Control.

ANTENNAS

CBU-1 "UTILITY" ANTENNA.....$9.95
Good coverage, portable antenna for temporary mobile or fixed installations. 45½" base-loaded antenna, 12' connecting cable, mounting bracket and clip. 3 lbs.

CBM-1 "MOBILE" ANTENNA.....$19.95
Best coverage mobile installation. Easy to install spring base, ¼ wave, 9' whip; 15' connecting cable and necessary hardware. 7 lbs.

CBF-1 "FIXED LOCATION" ANTENNA...$19.95
Excellent coverage, ¼ wave "ground plane", 9' elements; 50' connecting cable and mounting bracket. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE

6 volt Vibrator Power Supply for use with 6 volt batteries.
KIT—Model VP-1-6. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-6. Shpg. Wt. 4 lbs.....$11.95

12 volt Vibrator Power Supply for use with 12 volt batteries.
KIT—Model VP-1-12. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-12. Shpg. Wt. 4 lbs.....$11.95

HEATHKIT

ORDER BLANK

NOTE: all prices and specifications subject to change without notice.
Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges —they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

HEATH COMPANY BENTON HARBOR 20, MICH.
a subsidiary of Daystrom, Inc.

Name_____

Address_____

City & Zone_____ State_____
(PLEASE PRINT)

SHIP VIA
☐ Parcel Post
☐ Express
☐ Freight
☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE
	☐ SEND FREE HEATHKIT CATALOG	POSTAGE	
		TOTAL	

HEATHKITS are also available at your Dealer see listing on next page

SIMPLIFY TEST and TROUBLE-SHOOTING PROCEDURES

with

KINGSTON TEST EQUIPMENT

Models EA-1 and VS-5 Kingston Absorption Analyzers provide electrostatic signal tracing and extreme sensitivity. For trouble-shooting any equipment with wave forms. CRT displays wave-form from each stage.

Model PO-1 Kingston Absorption Analyzer allows conventional oscilloscopes to be used in trouble-shooting electrostatically. Built-in speaker for use as an audio analyzer.

Accessory Probes for miniature, sub-miniature and shielded tubes. Also Direct Probe for use with VS-5 and EA-1. Transistor Radio Probe simplifies trouble-shooting of transistorized radios.

Model BB-1 Variable DC Source, battery-driven for use wherever a pure DC voltage is desired. Voltage can be varied and metered.

Probe-Master. Built-in capacitive network allows by-passing of stages, coupling of signals from one stage to another. Most versatile testing probe on the market. Complete with two clips and neon bulb.

WRITE TODAY FOR CATALOG

KINGSTON ELECTRONIC CORPORATION

MEDFIELD, MASSACHUSETTS, U. S. A.

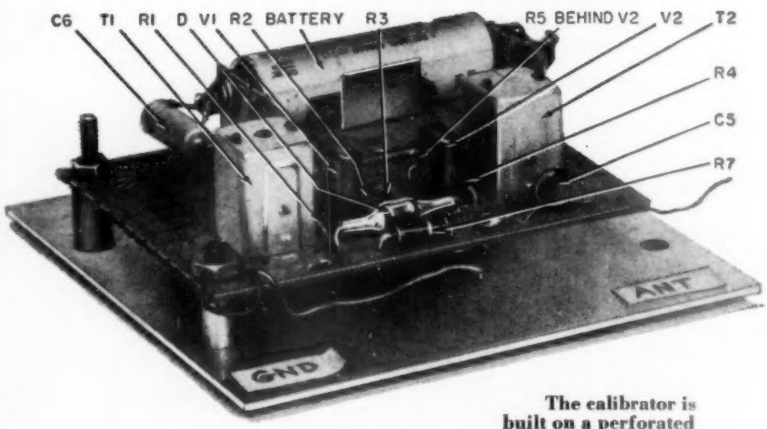
TEST INSTRUMENTS

SHORTWAVE CALIBRATOR

Two-transistor unit delivers a variety of extremely accurate frequencies

By I. QUEEN

EDITORIAL ASSOCIATE



The calibrator is built on a perforated phenolic board.

THIS little device helps calibrate shortwave receivers, marks ham bands and checks signal generators. It puts out strong signals at 100-kc intervals. They appear, for example, through the broadcast band at 600, 700, 800 kc. Still higher, they get weaker, but are still useful.

There is good reason for the strong output. This instrument is *not* a 100-kc generator, with weak rf output because of high harmonic order. Instead, there are two fundamentals and both are at relatively high frequencies. One oscillator is tuned to 400 kc, the other to 500. They are mixed in a diode to generate sum and difference beats.

No claim can be made for lab precision for this device, since it does not use crystals. However, any desired accuracy may be attained by comparing frequency with WWV as standard.

Parts are inexpensive and easy to get. Two penlight cells power the device. No switch is shown on the schematic; power is shut off by removing one of the batteries from its holder.

Calibrating the calibrator

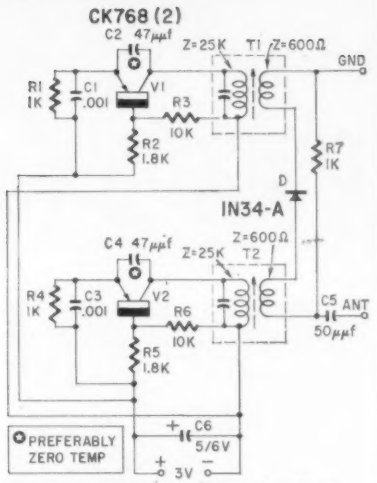
It is easy to adjust the calibrator's frequency with the help of an all-wave receiver. First, tune one if transformer (in the calibrator) to 500 kc by listening for a harmonic at a WWV frequency: 2.5, 5.0 or 10.0 mc. Do this with receiver bfo shut off. As you adjust the transformer core, you will hear a tone when the harmonic beats with WWV.

Now tune the second transformer to 400 kc. Listen in at 2 mc with the bfo off. As the core is adjusted to 400 kc, its fifth harmonic will beat with the fourth harmonic of 500 kc and you will hear the audio beat.

Tuning may also be done with a broadcast receiver if desired. Listen for 500-kc harmonics at 1,000 and 1,500 kc. Harmonics of 400 kc will be heard at 800, 1,200 and 1,600 kc. These signals will make a swish or hissing sound on a receiver without a bfo.

To illustrate the accuracy, suppose you hear a 1-kc beat to indicate that the (10th) harmonic of 500 kc is heterodyning with the WWV carrier at 5 mc. This means you are in error by 1,000 parts in 5,000,000 or .02%! If you tune closer to zero beat, you will obtain even greater precision.

You should now hear beats every 100



NOTE: TUNE ONE TRANSFORMER TO 400 KC, THE OTHER TO 500 KC

R1, 4, 7—1,000 ohms
R2, 5—1,800 ohms
R3, 6—10,000 ohms
All resistors ½-watt 10%
C1, 3—.001 μf, disc ceramic
C2, 4—47 μμf, zero temperature coefficient
C5—50 μμf, disc ceramic
C6—5 μf, electrolytic
All capacitors 6 volts or higher
BATT—3 volts, penlight cells (2 in series)
D—IN34-A
T1, 2—subminiature if transformers: primary, 25,000 ohms; secondary, 600 ohms (Lafayette MS-268 or equivalent)
CI, 2—CK768
Battery holder
Phenolic chassis board
Miscellaneous hardware

Circuit of the calibrator. T1 and T2 are 455-kc transistor if transformers. On MS-268's, terminal 3 goes to the collector, 5 goes to B— and 4 is not used. Secondary lugs are 1 and 2.

kc through the broadcast band and well into the short waves. On a receiver with bfo, they will be clear steady whistles.

To use the calibrator, couple it to a receiver by tying lead ANT to the antenna post and GND to ground. Disconnect your regular antenna, of course.

500-kc oscillator

You can easily convert this device to a straight 500-kc oscillator by removing the 400-kc transistor. Likewise, you will have a 400-kc oscillator if you remove the other transistor. As a 500-kc oscillator, for example, you will hear signals only at 1,000, 1,500, 2,000 kc, etc.

To adjust a 455-kc if transformer to 500 kc you must turn the core (with a small, insulated screwdriver) counterclockwise nearly all the way. For 400 kc, turn it clockwise nearly all the way. Of several transformers tried, these frequencies were reached in every one. Sometimes you may have to force the core screw slightly to reach the desired frequency. This causes no damage if only a small fraction of a turn is needed past the limiting stop. To *lower* frequency you may add a small capacitor (about 25 μμf) across the transformer primary. END

Here's where to buy your HEATHKIT locally . . .

CALIFORNIA
BERKELEY — zacKIT Corporation
CHICO — Dunlap Radio & TV
EL CAJON — Telrad Electronics
FRESNO — Dunlap Radio & TV
LOS ANGELES — Kierulff Sound Corporation (2 Locations)
MARYSVILLE — Dunlap Radio & TV
MERCED — Dunlap Radio & TV
MODESTO — Dunlap Radio & TV
PALO ALTO — Zack Electronics
RIVERSIDE — Kierulff Sound Corporation
SACRAMENTO — Dunlap Radio & TV
SAN DIEGO — Telrad Electronics
SAN FRANCISCO — Zack Electronics
SANTA BARBARA — zacKIT Corporation
STOCKTON — Dunlap Radio & TV
TARZANA — Kierulff Sound Corporation
VISALIA — Dunlap Radio & TV

DELAWARE
WILMINGTON — Radio Electric Service Co.

FLORIDA
COCOA — Thurow Distributors, Inc.
DAYTONA BEACH — Thurow Distributors, Inc.
JACKSONVILLE — Thurow Distributors, Inc.
MIAMI — Thurow Distributors, Inc.
ORLANDO — Thurow Distributors, Inc.
PENSACOLA — Thurow Distributors, Inc.
ST. PETERSBURG — Thurow Distributors, Inc.
TALLAHASSEE — Thurow Distributors, Inc.
TAMPA — Thurow Distributors, Inc.

ILLINOIS
ALTON — Radonics—Alton, Inc.

INDIANA
FORT WAYNE — Ft. Wayne Electronics Supply, Inc.
INDIANAPOLIS — Graham Electronics Supply, Inc.
LAFAYETTE — Lafayette Radio Supply Co., Inc.
MUNCIE — Muncie Electronics Supply, Inc.

IOWA
DES MOINES — Radio Trade Supply Co.
FORT DODGE — Radio Trade Supply Co.
MARSHALLTOWN — Radio Trade Supply Co.
WATERLOO — Radio Trade Supply Co.

LOUISIANA
LAFAYETTE — Sterling Electronics, Inc.

MARYLAND
BALTIMORE — American Distributing Co. (2 Locations); The Hi-Fi Shop
SALISBURY — Radio Electric Service Co.

MASSACHUSETTS
BOSTON — Audionics, Incorporated

MICHIGAN
ALLEN PARK — Volta Electronics
DETROIT — High Fidelity Workshop
PONTIAC — High Fidelity Workshop

MINNESOTA
DULUTH — Lew Bonn Company
LA CROSSE — Lew Bonn Company
MINNEAPOLIS — HI-FI Sound; Lew Bonn Company
ST. PAUL — HI-FI Sound; Lew Bonn Company

MISSOURI
ST. LOUIS — Radonics (2 Locations); Radonics-West, Inc.; Radonics-Gravois, Inc.

NEW JERSEY
ATLANTIC CITY — Radio Electric Service Co.
CAMDEN — Radio Electric Service Co.
MOUNTAINSIDE — Federated Purchaser, Inc.
NEWARK — Federated Purchaser, Inc.

NEW YORK
ALBANY — Fort Orange Radio Dist. Co., Inc.
BATH — Rochester Radio Supply Co., Inc.
BELLEROSE — Cross Island Electronics, Inc.
BINGHAMTON — Stack Electronics, Inc.
BROOKLYN — Acme Electronics, Incorporated
ELMIRA — Stack Electronics, Inc.
FARMINGDALE — Gem Elec. Distributors, Inc.
FOREST HILLS — Beam Electronics, Incorporated
GENEVA — Rochester Radio Supply Co., Inc.
HERKIMER — Herkimer Electronics Co., Inc.
HICKSVILLE — Gem Elec. Distributors, Inc.
MINEOLA — Arrow Electronics, Incorporated
MT. VERNON — Davis Radio Distributing Co., Inc.
NEW YORK — Arrow Electronics, Incorporated; Harvey Radio Company
ROCHESTER — Rochester Radio Supply Co., Inc.
SYRACUSE — Syracuse Radio Supply Co., Inc.
UTICA — Genesee Electronics Company
VALLEY STREAM — Elm Electronics, Inc.
WATERTOWN — Watertown Electronics Company

NO. CAROLINA
CHARLOTTE — Southeastern Radio Supply Co.
FAYETTEVILLE — Southeastern Radio Supply Co.
GREENSBORO — Southeastern Radio Supply Co.
KINSTON — Southeastern Radio Supply Co.
RALEIGH — Southeastern Radio Supply Co.

OHIO
AKRON — Sun Radio Company
CHILLICOTHE — Buckeye Electronics Dist., Inc.
CLEVELAND — Pioneer Electronic Supply Co. (2 Locations)
COLUMBUS — Buckeye Electronics Dist., Inc.
DAYTON — Ham 'n Hi-Fi, Inc.
LORAIN — Pioneer Electronic Supply Co.
MAPLE HEIGHTS — Pioneer Electronic Supply Co.
NEWARK — Buckeye Electronics Dist., Inc.
SANDUSKY — Pioneer Electronic Supply Co.
SPRINGFIELD — Standard Radio-Springfield, Inc.
TOLEDO — Lifetime Electronics
ZANESVILLE — Buckeye Electronics Dist., Inc.

OREGON
PORTLAND — Eccles Electric Company
SALEM — Cecil Farnes Company

PENNSYLVANIA
ALLENTOWN — Federated Purchaser, Inc.
EASTON — Federated Purchaser, Inc.
ERIE — J. V. Duncombe Co. (2 Locations)
PHILADELPHIA — Austin Electronics, Inc.; Radio Electric Service Co. (3 Locations)
PITTSBURGH — House of Audio
WILLOW GROVE — Radio Electric Service Co.
YORK — Radio Electric Service Co.

RHODE ISLAND
PROVIDENCE — Audionics, Incorporated

TEXAS
BEAUMONT — Sterling Radio Products, Inc.
BRYAN — Sterling Radio Products, Inc.
DALLAS — Hillcrest Records & HI-FI
HOUSTON — Sound Equipment, Incorporated; Sterling Radio Products, Inc.
LUFKIN — Sterling Radio Products, Inc.

VIRGINIA
ARLINGTON — Key Electronics, Inc.
NEWPORT NEWS — Cain Electronics Company, Inc.
NORFOLK — Cain Electronics Company, Inc. (2 Locations)
PORTSMOUTH — Cain Electronics Company, Inc.
RICHMOND — Meridian Electronics, Inc.

WASHINGTON
SEATTLE — Seattle Radio Supply, Inc.

WISCONSIN
MADISON — Hi-Fi Corner; Satterfield Electronics, Inc.
MILWAUKEE — Hi-Fi Center; Netzow's

Careful selection of reliable qualified dealers is a slow process . . . so please bear with us if your area has not been covered. Thank you.

New York Service Representative
Empire State Electronic Serv., Inc.
180-14 Union Turnpike
Flushing 66, Long Island, New York

HEATHKIT
HEATH COMPANY / Benton Harbor, Mich.
a subsidiary of Daystrom, Inc.

Two indicating meters give instant and accurate details on the condition of the transistor being checked

TECHNICIAN'S TRANSISTOR CHECKER

By JOSEPH E. PONTIUS*

WHAT should a transistor checker do? Recently I was faced with this question when I had to design a simple, efficient transistor tester to be used by shop personnel in the manufacture of transistorized test equipment. The results were satisfactory, and I am pleased to pass the ideas on to you.

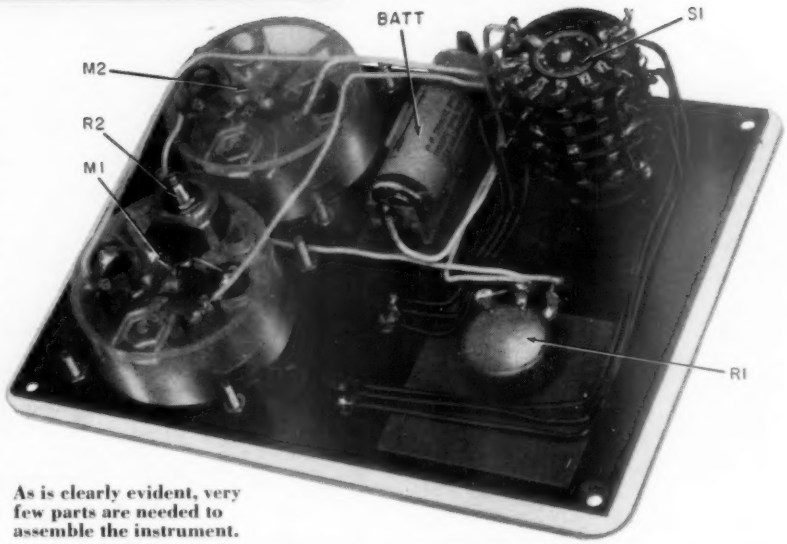
First, the checker must make the basic tests found in all transistor data sheets. From such values of I_E, I_C, I_{CO}, I_B, alpha and beta, other characteristics may be calculated or curves plotted to provide additional information.

Second, the information presented must be simply displayed so untrained personnel can determine not only which transistors are shorted, open or otherwise worthless, but which are most applicable to the job, such as matching pairs, selecting high beta or low I_{CO}, or otherwise use only the information displayed without the delay and inconvenience of computation.

And last, the instrument should be both simple to operate and inexpensive to build.

The transistor tester described here consists of a range switch, a potentiometer for adjusting base current, two transistor sockets, a battery and two meters. Perhaps it would be still more economical to use only one meter and add an extra switch, making the remaining meter do double duty; but I feel this would be false economy since the double meter provides a definite safety factor for both the transistor and the meters and makes the test simpler and more complete.

The battery is a 4-volt mercury unit. It was chosen over a conventional 4.5-volt battery for its stability and long shelf life. If surface-barrier transistors will be tested, it should be no higher than 4.5 volts. This value was selected, because in preference to the 22.5 volts used in many other testers, most transistor manuals and data sheets give 5 volts as the collector voltage at which alpha and beta were measured, and these are the sources of data with which we compare the results of our test.



As is clearly evident, very few parts are needed to assemble the instrument.

The operation of the tester may be approached in a number of directions. For general information, beta can be an important yardstick when selecting a transistor—for a common-emitter amplifier, for example. The switch should be turned to BETA for the proper type of transistor (NPN or PNP), the potentiometer turned to maximum resistance and the transistor inserted into its corresponding socket. Turn the pot until collector current reads exactly 1 ma. Beta is read on the base-current meter.

Selecting 1 ma for the collector current is also an effort to match the measuring conditions with the data sheet or transistor manual as nearly as possible. Actually, the instrument measures a simple relationship between base current and collector current, so any collector-current reference may be used which will more nearly match the conditions under which the transistor is to be used. However, the beta scale is calibrated for a 1 ma reference, and must be multiplied by the new reference to retain its accuracy.

Example: At 1 ma our hypothetical transistor gives a beta value of 20. This indicates that the base current is 1/20 of the collector current (1 ma). At 2 ma, the base current also increased in a 1-to-20 ratio, but now the beta reading is 10. Multiplied by 2, it becomes our original

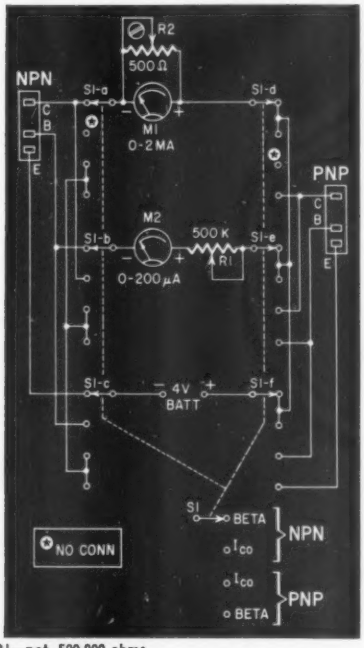
*Design engineer, Little Lab Co.

20. At 0.5 ma, the beta reading is 40: 40 times 0.5 equals 20.

How to use it

For extremely high-gain transistors, this practice may be required to provide a readable figure. It may also become useful when measuring extremely low gain to prevent the base-current meter from reading off scale.

I_{co} is the current which flows in the collector with the emitter open. Many testers simply open the base and call this "leakage," but this current is not the same as I_{co} and is not a standard

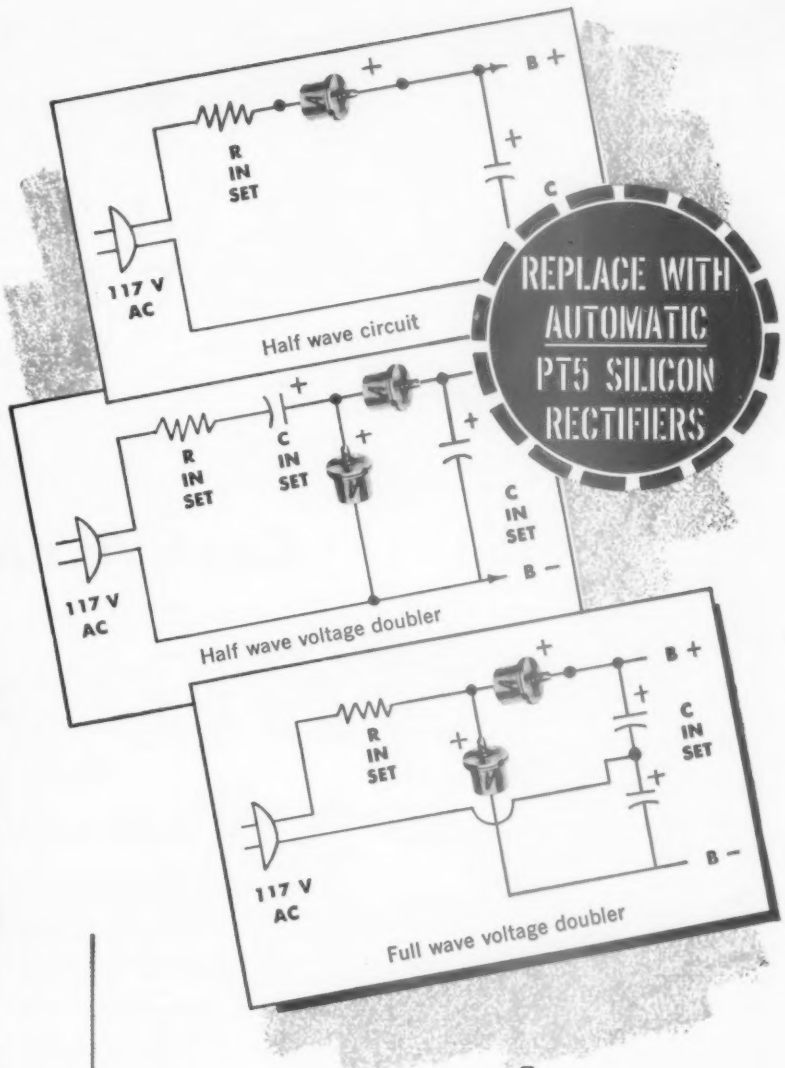


R1—pot, 500,000 ohms
R2—miniature pot, screwdriver adjust, 500 ohms
BATT—4 volts, mercury (Mallory TR133R or equivalent)
M1—dc meter, 2-ma full scale (meter used was 200-μa basic unit. Combination with R-2 makes it 2 ma full scale)
M2—dc meter, 200-μa full scale
SI—6-pole 4-position nonshorting rotary
Transistor sockets (2)
Bakelite case to suit
Miscellaneous hardware

Simple circuit of the technician's transistor tester.

transistor parameter. When the switch is turned to I_{co}, the base-current meter and its series resistor are moved into the collector circuit and the emitter is opened. While the 200-μa meter is more practical for this measurement than the 2-ma meter, it is also more susceptible to overload if the transistor being tested is shorted. In switching both the meter and the pot to the collector circuit, the potentiometer acts as a limiting resistor. Assuming that the transistor's I_{co} was high, during the BETA test beta would have been rather low and resistance would have been inserted in the base circuit to limit collector current to 1 ma. This would be the limiting resistance when I_{co} is read. Observing that the meter does not overload, the pot can be adjusted to zero resistance and I_{co} then read in microamps.

(*Continued on page* 80)



Every TV circuit works better with AUTOMATIC

PT5 SILICON RECTIFIERS

the universal replacement preferred by TV set manufacturers

Cut down expensive inventory, eliminate intricate installations — install the Automatic PT5 for top performance and maximum picture brightness!

GENERAL INSTRUMENT DISTRIBUTOR DIVISION
240 Wythe Avenue, Brooklyn 11, N. Y., EVergreen 8-6000

SELL THE ANTENNA LINE THAT HELPS YOU SELL!

Cash in on...

Winegard's

...the Industry's Greatest

SEE the big-name TV stars such as ★ Ward Bond of "Wagon Train" ★ Walter Brennan of "The Real McCoy's" and other TV stars promoting Winegard Color'Ceptors!

SEE Winegard's advertising in a non-stop, big-space schedule in LIFE, Better Homes & Gardens, others, *ALL YEAR LONG!*

GET FREE PROFIT-MAKING SALES AIDS

GET Winegard's new "PROMOTION BUCKS"! Given to you free with every Color'Ceptor you buy. You use them for getting *your own choice* of the finest sales promotion aids anyone has ever offered — knock-out sales helps that hitch your business to the giant national sweep of *Winegard's BIG TV SHOW TIME!*

SEND THIS COUPON TODAY!

WINEGARD CO.
3013-10 Scotten, Burlington, Iowa

- ☐ RUSH full color brochure showing Winegard's new antenna dealer sales aids . . . and tell me how I can get them free!
- ☐ Send literature on Winegard's complete line of FM and TV antennas.

FIRM NAME_____

ADDRESS_____

Sell the Winegard Color'Ceptor, the only antenna that's GUARANTEED to give your customers the BEST reception — In the rare event, a customer of yours is not satisfied — Winegard will refund the list price of the antenna and YOU KEEP YOUR FULL PROFIT.

Talk to your Distributor or send coupon for the whole story.

FEATURE THE LEADER AND BE ONE!

Winegard Co.

3013-10 Scotten, Burlington, Iowa

OUT WHERE THE SALES BEGIN

As Advertised in

Year-round big-space national advertising featuring big name TV stars.

Color'Ceptor full-color mailing piece and full-color postcards for your direct mail program.

Special window decals.

Giant 6 foot 3-color metal road sign imprinted with your name.

Unlimited 50-50 co-op on local newspaper and radio advertising.

Big gold balloons for the kiddies.

BIG TV SHOW TIME!

All-Out Antenna Profit Drive!

Antenna check-up sheets.

INSIDE YOUR STORE

Colorful window streamers.

"Antenna Specialists" Shirt Emblems.

Attractive silk wall banners.

New Color'Ceptor display with gold anodized mast.

Gold anodized sample to hand out on service calls.

Illuminated plastic window sign.

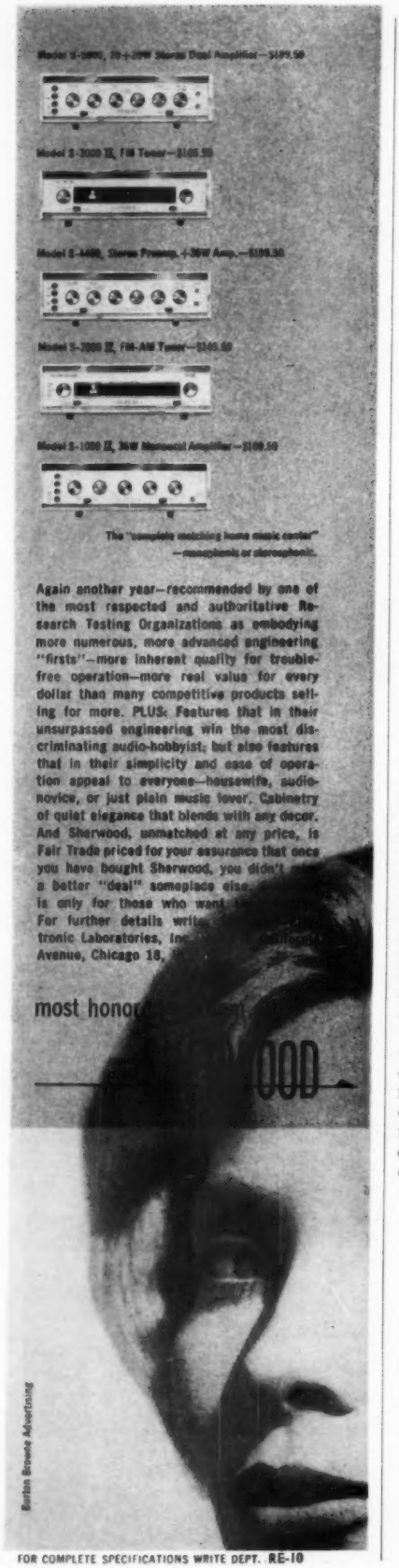
OUTSIDE YOUR STORE

Eye-catching metal flange sign.

Special truck decals.

Hanging store front sign imprinted with your name.

ALL THESE SALES AIDS FREE—Ask Your Distributor


Again another year—recommended by one of the most respected and authoritative Research Testing Organizations as embodying more numerous, more advanced engineering "firsts"—more inherent quality for trouble-free operation—more real value for every dollar than many competitive products selling for more. PLUS: Features that in their unsurpassed engineering win the most discriminating audio-hobbyist; but also features that in their simplicity and ease of operation appeal to everyone—housewife, audio-novice, or just plain music lover. Cabinetry of quiet elegance that blends with any decor. And Sherwood, unmatched at any price, is Fair Trade priced for your assurance that once you have bought Sherwood, you didn't
Avenue, Chicago 18.
most honor
OOD
Burton Browne Advertising
FOR COMPLETE SPECIFICATIONS WRITE DEPT. RE-10

TEST INSTRUMENTS

CALCULATED BETA vs TESTER INDICATIONS

I_C	1ma	1ma	1ma	1ma	1ma
I_B	200μa	100μa	50μa	25μa	12.5μa
$I_E=(I_C+I_B)$	1.2ma	1.1ma	1.05ma	1.025ma	1.0125
Calculated Alpha $\left(\frac{I_C}{I_E}\right)$	.83	.909	.95	.975	.987
Beta (Meter)	5	10	20	40	80
Calculated Beta $\left(\frac{\alpha}{1-\alpha}\right)$	4.88	9.99	19.8	39.8	79.6

(*Continued from page 77*)

An alpha scale can be added to the base-current meter if desired, or the currents may be compared. The comparison method is preferred, as it is more versatile and accurate.

I_B plus I_C equals I_E. Alpha equals ΔI_C divided by ΔI_E and is always less than unity.

Beta is equal to alpha divided by 1 minus alpha and is always more than unity. It may be seen that the nearer alpha approaches 1, the higher beta will be.

Actually these simple relationships are not entirely true as read by the meter, for they will vary slightly with variations in I_{CO}, collector voltage and meter nonlinearity. Using the collector current for our standard 1 ma rather than the emitter would cause beta to be calibrated at odd points on the meter scale. However, I feel that the measurements are within the accuracy readable by the meter as they constitute an error of only 1% or less in most cases (see chart).

In matching transistor pairs, whether they be both n-p-n, p-n-p, or one of each, three important points should be matched: input impedance, beta and output impedance. While the tester is not calibrated for measuring input and output impedances, the dc component or resistance function can be matched by observing base and collector currents at known collector voltages, or the two currents can be plotted on a graph to determine the ac slope or small-signal impedance. If a number of transistors are available for matching, test them in the usual manner and select the ones nearest the gain desired. Then, without moving the setting of the potentiometer, and noting the base- and collector-current readings, insert the selected transistors one after the other until one is found which equals the first transistor in both readings.

Further tests or graphs may be made as desired. Since switching from NPN to PNP does not change the testing circuitry, but merely the position of the transistor in the circuit, complementary pairs may be matched with ease. For such tests both sockets may be used at once, since the alternate socket is on what might be called standby and will not affect the test being made on the other.

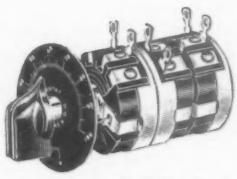
While the tester measures the transistor characteristics mentioned above, it also gives rapid, logical indications relating to transistor rejection, or the bad ones on the "good–bad" testers. For example, a collector-to-base short will cause a high collector current not controllable by the potentiometer. A base-to-emitter short will make it impossible to raise collector current to 1 ma. An

Full-size drawing of meter face with alpha scale added.

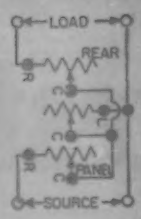
CLAROSTAT CONTROLS FOR AUDIO

CONSTANT IMPEDANCE CONTROLS

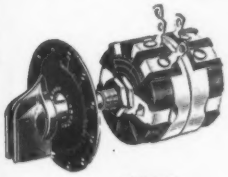
Clarostat Constant Impedance T-pads are utilized in circuits to maintain constant required values for perfect balancing. In either input or output. Knob and dial are supplied. Resistance range available of 4 to 2,000 ohms. 10 watts audio.



SERIES CIT

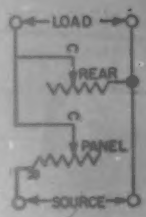


CONSTANT IMPEDANCE CONTROLS

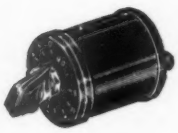


SERIES CIL

For circuits requiring an L-pad, to maintain balance of associated circuitry. Provide continuous range of from 0.5 to 30 db attenuation in 90% of rotation; last 10%, infinite attenuation. Handles up to 10 watts audio. Resistance range of 4 to 2,000 ohms. Knob and dial included.

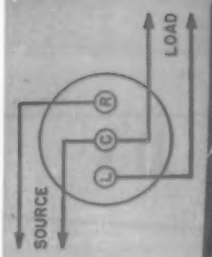


CONSTANT IMPEDANCE OUTPUT ATTENUATORS

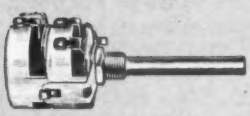


SERIES CIB

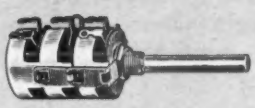
Handle up to 30 watts audio. Linear attenuation in 3 db steps up to 24 db, then 30 db. Recommended as an output attenuator to individual speaker or group of speakers, or as input attenuator to power amplifier. Resistance range of 6 to 600 ohms. Single-hole mounting. Knob and dial included.



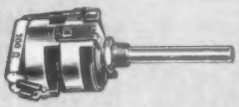
SPACE-SAVING CONSTANT IMPEDANCE ATTENUATORS



SERIES CIL43



SERIES CIT43



SERIES CIBT43

These units provide audio control at low cost and in minimum space. They will handle up to 4 watts audio and are ideal for individual-speaker control. Resistance range of 4 to 500 ohms.

CIT43 and CIBT43 have constant input and output impedances, while CIL43 has constant input impedance only.

WRITE FOR COMPLETE DETAILS ON CLAROSTAT SOUND SYSTEM CONTROLS

More good reasons for always saying

CLAROSTAT MFG. CO., INC., DOVER, N. H.

CLAROSTAT ®

What's the latest score on cartridges?

1ST	ceramic cartridge was invented by Sonotone...
13	years ago. Today, over...
65	different manufacturers have specified Sonotone for...
662	models of high-quality phonographs. Altogether over...
9,000,000	Sonotone Ceramic Cartridges have been used for original and replacement purposes. ('Nuff said!)

Sonotone CORP.

Electronic Applications Division, Dept. CE-109

ELMSFORD, NEW YORK

In Canada, contact Atlas Radio Corp., Ltd., Toronto

Leading makers of fine ceramic cartridges, speakers, microphones, electronic tubes.

TEST INSTRUMENTS

Many low-power transistors, both p-n-p and n-p-n, were tested. The instrument was found easy to use and read. Beta values compared very closely to those obtained on another dc beta tester known to be accurate.

On I_{co}, most transistors measured near zero. Another checker showed that these units had low leakage. Two or three other units showed 100 μa or more I_{co} on M2. These units slammed M1 way past full scale during beta tests, regardless of potentiometer setting.

For maximum meter protection the following procedure was found simple and suitable: First test for I_{co} with pot turned down. Advance gradually, watching I_{co}. **If it reaches 100 μa or more, don't test for beta or you may injure the meter.**

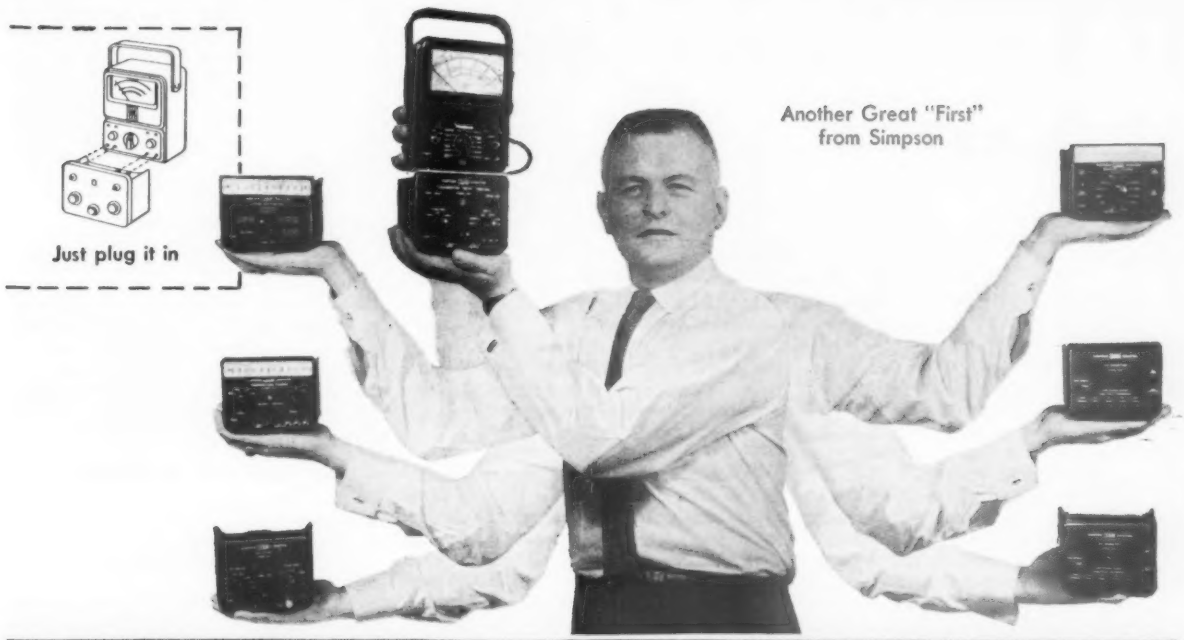
open collector will show no collector current, but will show base current. An open emitter will show no collector current until checked in the I_{co} test. An open base will show a very small collector current which the pot has no control over and no I_{co}.

Power transistors may be given a good–bad check by measuring I_{co} with the switch in the BETA position. This will be read on the 2-ma meter. Manufacturers advise that over 2 ma is excessive I_{co} for a power transistor. To make this test, connect the transistor collector to the socket collector, the base of the transistor to the socket *emitter* pin and leave the transistor emitter open. **Testing a power transistor in the conventional manner will damage the meters.**

It is difficult to make a comprehensive power check for transistors in a tester of this type. The maximum power limits must not be exceeded, while at the same time the test should define these maximum limits. For this reason, power transistors were not included as part of the range of this instrument, with the exception of I_{co} as just mentioned.

This transistor checker was worth the effort put into it, and it is earning its keep. END

New Simpson "Add-A-Testers"



Converts your 260* into seven different testers!

Think of it! A small investment turns your 260 VOM into a whole array of testers—equipment with a quality that is found only in individual pieces of test equipment at much higher prices. The secret lies in combining an adapter with the *top-notch meter and circuitry* of your 260.

Each combination of Add-A-Tester unit and 260 is self-contained, self-powered. Each adapter goes on and off in a jiffy. No gadgets, no complicated connections. Furthermore, Add-A-Tester units require only 1/2 to 1/3 the storage space of individual testers. By reducing bench clutter, this compactness makes jobs go faster, raises shop efficiency. Make your 260 do double duty. Stop in at your Electronics Parts Distributor or write the factory for further information.

*Trademark

TRANSISTOR TESTER, Model 650.....$26.95
Beta Ranges: 0-10, 0-50, 0-250, (F.S.)
Beta Accuracy: ±3%, with 260 ±5% nominal
Ico Range: 0-100 ua
Ico Accuracy: ±1%, with 260 ±3% (F.S.)

DC VTVM, Model 651.....$32.95
Voltage Ranges: 0-.5/1.0/2.5/5.0/10/25/50/100/250/500
Accuracy: ±1%, with 260 ±3% (F.S.)
Input Impedance: greater than 10 megs all ranges

TEMPERATURE TESTER, Model 652.....$38.95
Temperature Ranges: −50°F to +100°F, +100°F to +250°F
Accuracy: with 260 ±2° (nominal)
Three lead positions provided
Sensing Element: thermistor

AC AMMETER, Model 653.....$18.95
Ranges: 0-0.25/1/2.5/12.5/25 amps
Accuracy: ±1%, with 260 ±3% nominal
Frequency Range: 50 cycles to 3000 cycles

AUDIO WATTMETER, Model 654.....$18.95
Load Ranges: 4,8,16,600 ohms
Wattage: Continuous 25 watts (8,600 ohms)
50 watts (4,16 ohms)
Intermittent 50 watts (8,600 ohms)
100 watts (4,16 ohms)
Accuracy: ±5%, with 260 ±10% nominal
Direct reading scale from 17 microwatts to 100 watts

MICROVOLT ATTENUATOR, Model 655 .$18.95
Ranges: 2.5 microvolts to 250,000 microvolts continuously variable in decade steps
Frequency: DC to 20 KC
Accuracy: ±1db

BATTERY TESTER, Model 656.....$19.95
Checks all radio and hearing aid batteries up to 90 volts at the manufacturer's recommended load, or any external load.

Note: All Simpson 260 Adapters provide for normal 260 usage without disconnecting the adapter.

Simpson ELECTRIC COMPANY

5219 West Kinzie Street • Chicago 44, Illinois
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd., London, Ontario

WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

TV Service CLINIC

conducted by

ROBERT G. MIDDLETON
RADIO-ELECTRONICS TELEVISION CONSULTANT

VIDEO-FREQUENCY testing is not difficult, if the basic principles are clearly recognized. The test setup is shown in Fig. 1.

First, a double curve with trace and retrace is displayed, as seen in Fig. 2. The generator phasing control is adjusted to bring trace and retrace into phase (layover). Then the zero-volt blanking switch is used to convert the retrace into a zero-volt base line.

As in Fig. 3, the zero-frequency point appears in the center of the pattern when the sweep generator is tuned to "0." Sometimes the zero-frequency point is displayed as a "marker" (Fig. 3). Other times the zero-frequency point looks like a "notch" (Fig. 2). This depends upon the characteristics of the generator and the demodulator probe.

We tune the sweep generator to bring the zero-frequency point to the end of the base line, as illustrated in Fig. 4. It makes no difference whether zero frequency appears at the left-hand or right-hand end of the base line.

Most video-frequency sweep generators have some type of built-in marker indication. The markers are used to identify frequency points on the curve, as shown in Fig. 5.

Leave the yoke behind

Sometimes when I have to pull a chassis I would like to avoid having to pull the yoke as it would be a great timesaver.—A. S., New York, N. Y.

You could use a yoke substitution box, with a 5- or 8-inch test picture tube. These will not accommodate all flybacks, of course, but are suitable for the more commonly used types. Your parts jobber can supply you with literature on commercial units.

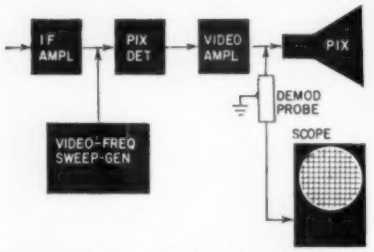


Fig. 1—Test setup for checking video amplifiers.

Poor width

I have run into insufficient width and picture blooming on a Videola 1531 after conversion to a 21EP4 picture tube. The high voltage measures 12 kv. —W. N., Santa Monica, Calif.

Inadequate width is caused by low deflection voltage to the yoke. Blooming will occur at 12 kv because the brightness control must be turned too high. The remedy is to bring up the voltages in the flyback system. First, the drive to the 6BG6 should be advanced. I assume that this has already been tried. The plate voltage on the horizontal oscillator and horizontal discharge tubes can be increased somewhat, to obtain more drive. Also, the 5,100-ohm screen resistor can be reduced to raise the screen voltage. However, it should not be raised above the point that gives more than 400-ma peak, or 110-ma average cathode current in the 6BG6. If the voltages are still insufficient, install a heavier flyback, to match the present yoke.

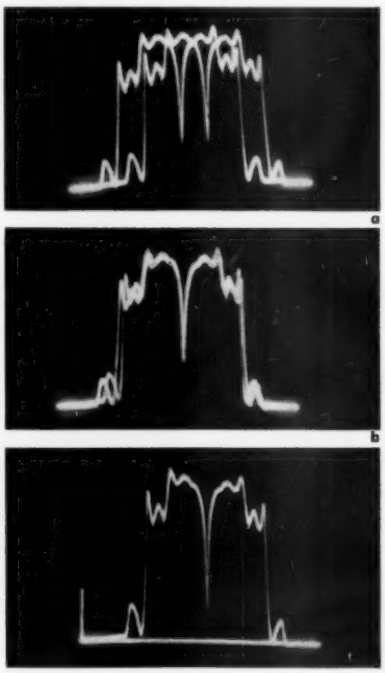


Fig. 2—Steps in getting proper display of the video amplifier response curve: a—Double response curve, trace and retrace out of phase. b—Phasing control adjusted for layover of trace and retrace. c—Retrace blanking switch on. Retrace is converted to a zero-volt base line.

60-cycle buzz

We recently repaired a Magnavox CT-332 that had age trouble. A signal generator shows that the age follows the input signal level properly. However, there is a 60-cycle buzz which can be minimized by adjusting the fine-tuning control, but cannot be eliminated. Alignment has been made in accordance with the service data.—W. J. C., Waukegan, Ill.

First, determine whether this is a case of sync, vertical sweep or vertical blanking buzz. Sync buzz does not change in tone as the vertical hold control is turned through its range (to make the picture roll). On the other hand, sweep or blanking buzz will change tone. To eliminate sweep buzz, replace faulty decoupling capacitors connected to the vertical sweep system. Blanking buzz can be eliminated by correcting or improving the shielding of the audio input circuits against stray fields from the high-voltage section and the picture tube. To check for sync buzz caused by if overloading, use override age bias. If this clears up the buzz, the age circuit needs attention. If not, check the position of the sound carrier on the overall response curve. It should not be higher than 10% on the curve. Align to control the sound-carrier height. Sync buzz is also caused by incorrect

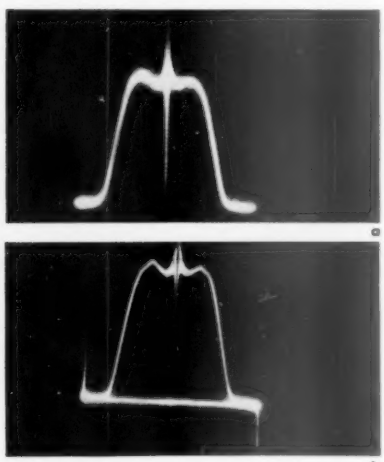


Fig. 3—The zero frequency point often appears as a marker: a—Video response curve with generator tuned to zero frequency. b—Same curve with retrace converted to zero-volt base line.

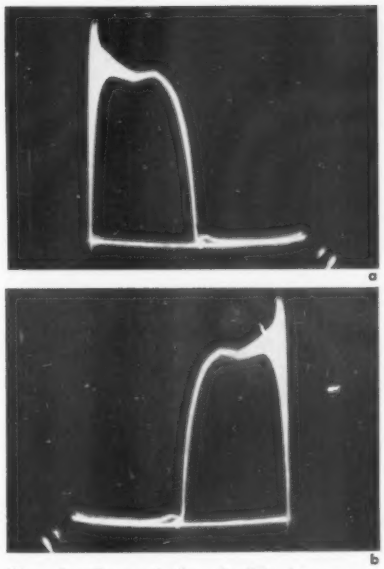


Fig. 4—One of the double images is tuned off the base line to bring the curve into a standard form. Either left or right side may be used.

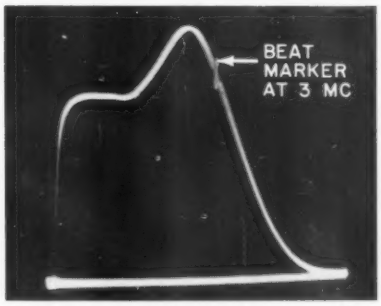


Fig. 5—Beat marker display on a video response curve.

dc voltages at the limiter tube, and misalignment of the sound if section.

Buzz by pix tube

I have cured the buzz in an Emerson 603146, but would like to ask why the condition caused sound buzz. When the grounding wires to the picture-tube coating made poor contact, the buzz was heard. However, when the brightness control was turned down, the buzz stopped. I do not believe the buzz is radiated from the picture tube.—L. S., Santa Monica, Calif.

This is a definite case of vertical blanking buzz. The picture-tube coating operates as a high-voltage filter capacitor. If disconnected, high-voltage regulation is poor. The voltage kicks up and down as the vertical blanking pulse passes. Stray fields from the picture tube or from the high-voltage wiring affect the audio input system because of poor high-voltage regulation. The buzz disappears when the brightness control is turned down, because the beam current then remains constant, and the poor high-voltage regulation

Now Completely SELF-CONTAINED
For Testing & Rejuvenating
BLACK AND WHITE and COLOR including 110° TUBES
NEW CRT 440
CATHODE REJUVENATOR TESTER
B&K
TESTS AND REJUVENATES all black & white and color picture tubes at correct filament voltage from 1 to 12 V.
TESTS AND REJUVENATES 110° tubes with 2.34, 2.68, 6.3 and 8.4 volt filaments.
TESTS AND REJUVENATES color picture tubes. Checks each color gun separately same as black & white tubes.
Used by Thousands of Professional Servicemen
MAKES NEW PICTURE TUBE SALES EASIER
Gives you more value than ever—all-in-one. Quickly checks and corrects most TV picture tube troubles in a few minutes right in the home without removing tube from set. Gives new useful life to weak or inoperative tubes. Checks leakage. Restores emission and brightness. Repairs inter-element shorts and open circuits. Life test checks gas content and predicts remaining useful life of picture tube. Completely self-contained in leatherette-covered carrying case. Net, $69.95
ACCESSORIES for USE ONLY with FORMER B&K Models 400 and 350 CRT
Model C40 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates TV color picture tubes and 6.3 volt 110° picture tubes. Net, $9.95
Model CR48 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates 110° picture tubes with 2.34, 2.68, and 8.4 volt filaments. Net, $4.95
See your B&K Distributor or Send now for Bulletin ST24-E
B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

Hand crafted speaker and equipment
CABINETS
for monaural and stereo hi-fi systems
Each cabinet made to order from selected woods with the care and attention to detail found only in fine custom cabinetry. All designs proved practical in service, affording ample ventilation and ideal acoustical response.
Write for free illustrated brochure
CUSTOM DESIGN OF WESTCHESTER, INC.
516 West Post Road, Mamaroneck, N.Y.

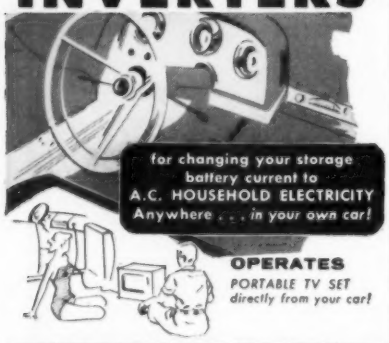
Operate your . . .

• tape recorder • P. A. system
• portable TV set • hand tools

FROM YOUR CAR, Boat or Plane!

with ATR

INVERTERS

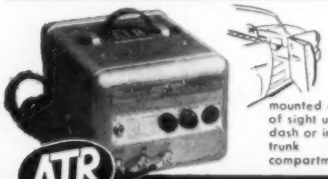


OPERATES
PORTABLE TV SET
directly from your car!

OPERATES
• RADIOS
• RECORD PLAYERS
• MIXMASTERS, ETC.
directly from your car!

MAKE YOUR CAR, BOAT OR PLANE
"A ROLLING OFFICE!"

OPERATES
• TAPE RECORDERS
• DICTATING MACHINES
• PUBLIC ADDRESS SYSTEMS
• ELECTRIC SHAVERS
directly from your car!



mounted out of sight under dash or in trunk compartment

UNIVERSAL
INVERTERS

Especially designed to change 6 or 12 volt D.C. to 110 volt A.C. 60 cycles.
for . . .

• EXECUTIVES • POLICEMEN
• SALESMEN • REPORTERS
• OUTDOOR MEN • FIREMEN
• PUBLIC OFFICIALS

MODELS 6U-RHG (6 volts) 125 to 150 watts. Shipping weight 27 lbs. List price $99.50
DEALER NET PRICE $66.34
12U-RHG (12 volts) 150 to 175 watts. Shipping weight 27 lbs. List price $99.50
DEALER NET PRICE $66.34

Write for literature on other Sizes and Models of ATR INVERTERS, priced as low as $11.95 list.

SEE YOUR JOBBER OR WRITE FACTORY

√NEW MODELS √NEW DESIGNS √NEW LITERATURE
• "A" Battery Eliminators • DC-AC Inverters • Auto Radio Vibrators

ATR AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA, U. S. A.

TELEVISION

does not cause a high-voltage transient. Adequate high-voltage filtering capacitance acts as a storage tank for beam current, and gives better high-voltage regulation.

Width problem

I am working on an RCA KCS-47 which is puzzling. A 50-volt 2-μf agc filter was shorted. Replacement gives fair pix and sound on all channels. There is a slow buildup of width when the receiver is first turned on. The raster is about 6 inches wide at first, and builds out to nearly full-screen in about a minute. The waveforms are unusual (see Fig. 6). They show tilt, loops and kinks, which I cannot find explained in any book or magazine. I note that the scope is sensitive to hand capacitance near the input terminals when a low-capacitance probe is used.—M. W. D., Canoga Park, Calif.

I would suggest, first, that the faulty electrolytic you replaced is not the only offender in this chassis. I suspect that the plate-supply voltage to the flyback system is coming up slowly because of unformed electrolytics, which re-form slowly after the receiver is turned on. The faulty electrolytics are probably running hot. They should be replaced. The tilt, curls and loops in the waveforms are caused by pickup of stray sweep and high-voltage fields by the scope's vertical and horizontal input terminals. This is a common but often overlooked cause of this form of distortion. The scope input terminals should be shielded for use with a low-capacitance probe. The higher-priced scopes usually have coaxial input connectors instead of binding posts.

Collapsing picture

I recently replaced the yoke in a Motorola TS-118B. The 100,000-ohm resistor in the old yoke was burned out. I have found a variation in the voltage divider. Occasionally the picture collapses horizontally and then expands to normal, with a clicking sound.—H. C. M., Oak Park, Ill.

This report indicates the continued presence of yoke trouble. The modified voltage-divider circuit would not be expected to be the cause of these symptoms. I have seen similar cases in which the windings in the vertical yoke section opened and burned out the shunt resistor (see Fig. 7). In your instance, the symptom is intermittent horizontal collapse, pointing to a transient open in the horizontal yoke winding. Evidently, the open does not persist long enough to burn out the resistor. The yoke should be checked. Even though it is new, it may be bad.

Aluminized tube?

A customer has asked us to install an aluminized picture tube in a Muntz 17B2. If this is practical, what type tube should be used? There is 14.5 kv available now. Should the high voltage be increased?—A. K. P., New York City

It is possible to use either a 20CP4 or

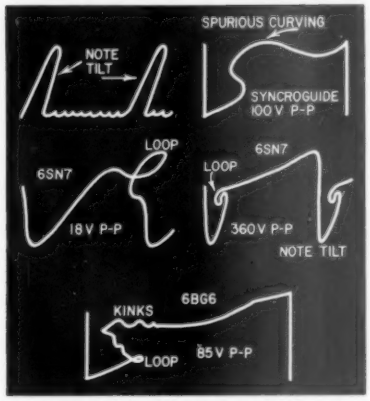


Fig. 6—Tilted, kinked and looped waveforms that result from pickup of stray horizontal circuit fields by the scope input terminals.

a 20CP4-B, but adequate scan may require a change of flyback, and possibly the yoke. If you have marginal width now, scan will be insufficient with the new tube. The 14.5 kv is in a range of voltage which could give a brighter picture with a 20CP4 than with an aluminized 20CP4-B. With more high voltage, it can be definitely stated that the 20CP4-B will give more brightness.

Poor pix and sound

What causes poor picture and sound reception in an Olympic 4CG26 when both sides of the lead-in are connected to the tuner? If one side of the lead-in is disconnected, reception is good.—J. J. B., Paterson, N. J.

This is a typical case of tuner regeneration. It could also be caused by reflected if regeneration. The usual cause is failure of a bypass or decoupling capacitor, either inside or outside the tuner. The best approach is to check the rf, if and overall rf–if response with a sweep generator. This will help localize the trouble. When regenerative

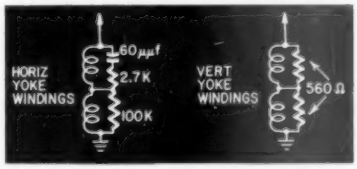


Fig. 7—Intermittently open yoke windings can cause failure of the shunt resistors.

voltages get back to antenna input terminals, response becomes unstable and changes with the input source impedance.

Pix-tube substitution

Is it practical to substitute a 17CP4 picture tube for a 17BP4-A?—B. J. G., Van Buren, Ohio

This conversion can be made, although there are mechanical considerations to be taken into account. The mounting for the tube must be modified, and the rim of the 17CP-4 must be insulated from the chassis. The

anode lead and connector will have to be changed. You can get the necessary insulating ring for the tube rim from an RCA supply depot.

Fading sound and picture

I was called to service an RCA KCS-81B with fading sound and picture. However, the chassis works OK in the shop. On a callback, I took a line-voltage reading at 115 volts, which dropped to 110 volts when a toaster was turned on. Then the fading occurred.—LeR. R. W., Jefferson, Wis.

Rather than attempting to rework the power supply to operate the chassis at 110 volts, I would suggest that the customer install an automatic line-voltage regulating transformer. If line voltage drops 5 volts on a toaster load, the problem becomes greater when a refrigerator or other heavy appliance switches into the line. An automatic transformer is the best answer.

Which sweep generator?

One of my friends recently purchased a medium-price sweep generator, but is not satisfied with its performance. What type of generator do you recommend?—R. C. W., Finksburg, Md.

The best basis of selecting a sweep generator is to balance the desired performance against price. This is usually a matter for individual judgment. Few shops can afford very expensive lab type generators, which, of course, provide the best performance. You can check the linearity, flatness and purity of signal output on a generator for comparative purposes. The tests shown in Fig. 8 are basic, and will give quantitative data on which to make a selection. END

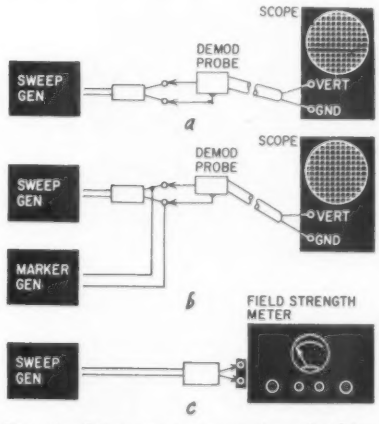


Fig. 8—Basic test setups for checking sweep generator output: a—Demodulator probe and scope check for flatness. Operate generator at 10-mc sweep width. Trace should be reasonably flat. b—Test setup to check sweep linearity. Marker should move the same distance on the scope trace for each megacycle increase of marker frequency. c—Field-strength meter shows microvolt output on each channel. Meter also shows presence of spurious outputs at off-channel frequencies.

To Make Your Components Sound NEW Again!

Available Singly and in Matched Pairs

THE FISHER
Laboratory Matched Tubes

Every new FISHER product has attained leadership for one essential reason: it filled a need which, until its introduction, no other comparable product could fully satisfy. FISHER Laboratory Matched TUBES have the same objective. If your high fidelity components sound "wrong" because of tube difficulties, FISHER TUBES can restore them to top performance again.

FISHER TUBES are *individually* selected to fulfill the maximum requirements of your components, *exactly* as specified by the manufacturer (no "variables," nothing less than the best *in every box.*)

FISHER TUBES are chosen for stability, maximum gain, low noise, exact tolerances, long life and for *absolutely identical performance characteristics,* as revealed by rigid comparison tests!

The next time you need any tubes, insist on FISHER.

Audio-Fans, Servicemen, Dealers—
WRITE TODAY FOR COMPLETE INFORMATION

FISHER RADIO CORPORATION, 21-40 44th Drive, L. I. C. 1, N. Y.

I want to know more about FISHER Laboratory Matched TUBES!

NAME _____

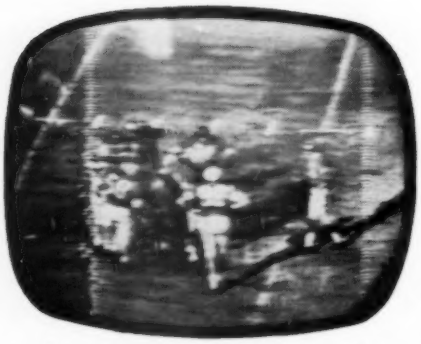
STORE NAME _____
(If a serviceman or dealer)

ADDRESS _____ CITY _____ STATE _____

Still more TV troubles presented in the way you run into them—as a picture on the TV screen

DIAGNOSE COMMON TV FAULTS

By A. V. J. MARTIN



Symptoms: One or two vertical white bars across the picture. They can be straight or ragged, and are generally narrow.

Diagnosis:
1. **Parasitic oscillation in the horizontal output tube.** Change the tube. Insert an rf choke or a 100-ohm resistor in the control-grid and screen-grid connections, at the tube socket. Sometimes, taping a small magnet to the tube will eliminate the oscillation.
2. **Incorrect horizontal adjustment.**
3. **Induction.** If the bar is wider and has ragged edges, it may be due to 15,750-cycle induction, for example on the picture-tube cathode or grid leads. Redress the leads. If necessary, replace the wire from the video output to the picture tube with a *short* length of coaxial cable and ground the outer braid at chassis.

Symptoms: Single horizontal white line across the screen.

Diagnosis: **No vertical sweep.** The defect can be anywhere in the vertical sweep section. To identify the stage, use headphones or a scope to trace the characteristic 60-cycle sawtooth signal. If signal appears on the plate of the output tube, look for a defective output transformer, yoke or associated components. Check shunt capacitor. If there is no signal on the plate but there is signal on grid of output tube, look for a defective tube, incorrect supply voltages or defective components. If no signal on plate of vertical oscillator, look for defective tube, wrong voltages or defective components. Check blocking oscillator transformers and resistances in shunt across it.

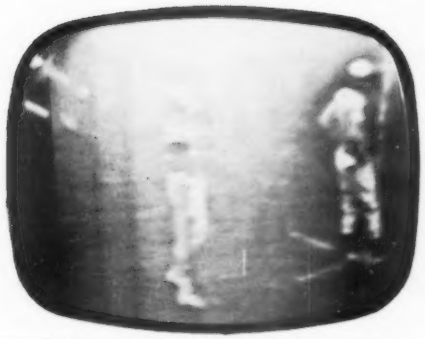
Symptoms: Tearing up of the picture or raster.

Diagnosis: **Oscillation.** Short detector load. If defect disappears, rf or if stages are guilty. If defect persists, video stages are at fault. Change tubes. Check lead dress, particularly grid and plate connections and the lead carrying the video signal to the picture tube. Check correction coils and shunting components by shorting them out. Check decoupling capacitors by bridging them with a good unit. Check voltages. If trouble still persists, look for faulty rf or if stages. Short the grids to ground through a capacitor until defective stage is found. Change tube. Check screens and lead dress. Verify tuning. Check decoupling components. Check voltages. Disable agc. If defect disappears, check agc system, particularly decoupling components.

Symptoms: A single vertical white bar across the screen.

Diagnosis:
1. **Lack of horizontal sweep.** Pattern does not change if brightness is increased, except for blooming. Defective horizontal coils or shunting components. Defective output transformer or associated components. Defective output or damper tubes. Incorrect grid drive on the output tube. Check grid voltage, which should be strongly negative. Components may be faulty or the horizontal oscillator does not function properly. Check tube, voltages and components.

   The best method here is to use a scope and observe and measure waveforms.
2. **Horizontal foldover,** always occurring in the left half of the screen, and due to damper tube or associated components. When brilliance is advanced, the sweep appears on the remaining portion of the screen. In other words, the bar is simply a more brilliant part of the raster. Change the tube, check components, including horizontal linearity circuit.



Symptoms: Black vertical bars, degrading to the right, on the left side of the screen.

Diagnosis: **Parasitic component in vertical sweep.** On close inspection, scanning lines appear wiggly but do not show velocity modulation. Check deflection yoke, particularly the components across vertical coils. Shunt a 0.5-μf capacitor across vertical yoke coils and across secondary of vertical output transformer. Rarely, the parasitic signal will enter the vertical sweep circuits directly. Best way to check and to identify point of entry is to use a scope. The culprit is probably a defective decoupling component or loose shield, or a lead improperly dressed.

Symptoms: Vertical lines wiggle.

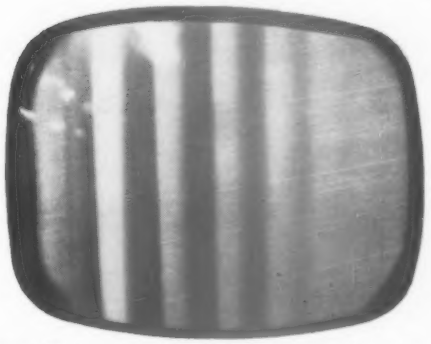
Diagnosis:
1. **Brigitte Bardot effect.** Horizontal sweep is modulated by a parasitic signal. Check deflection yoke for shunting components. Check horizontal output tube and stage. Check phase comparator; particularly time-constant circuit in control-voltage line.
2. **Poor filtering.** Shunt decoupling capacitors with unit known to be good.
3. **Excessive signal or saturation.** Check agc system. *Note:* In the photograph, the picture has been purposely uncentered to show the defect on the left-hand vertical side clearly.

Symptoms: Low brilliance. Picture too large, can't be reduced.

Diagnosis: **Defective high voltage.** Change high-voltage rectifier. Check associated components and circuitry, particularly filter capacitor (if used) and high-voltage lead. Check, readjust horizontal sweep section. Check tube, preferably by substitution.

Symptoms: Picture does not fill screen; vertical linearity poor.

Diagnosis:
1. **Insufficient height.** Adjust height and vertical linearity controls. Check vertical output and oscillator tubes and circuit components.
2. **Poor vertical linearity.** Adjust vertical linearity controls. Check vertical output tube and components.

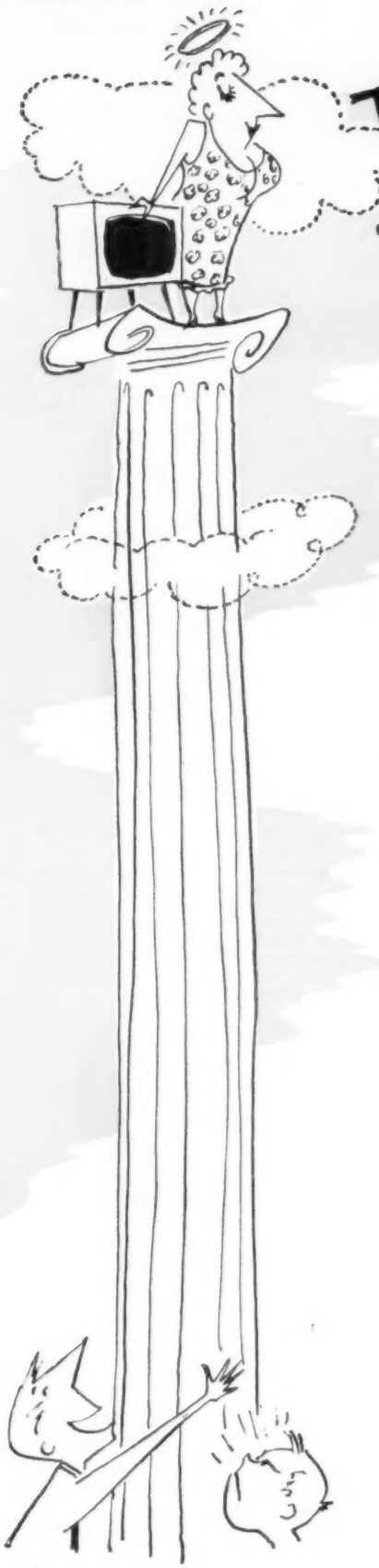


Symptoms: Black vertical bars, degrading to the right, on the left side of the raster.

Diagnosis: **Horizontal sweep transient.** Looking closely at the raster, note that the scanning lines are straight, but of varying brightness. This indicates velocity modulation. Check deflection yoke, particularly the components across horizontal coils. Look for defective horizontal output transformer. Change damper tube. Check associated components including horizontal linearity circuits.

Symptoms: Erratic variations of brilliance, eventually with tearing of the raster and jittery picture.

Diagnosis:
1. **Bad contact.** Can generally be confirmed by jarring the receiver. May be at the picture tube. Check socket and high-voltage connection. Look for an intermittent short in the picture tube. Poor or intermittent contact in the video stage or defective video tube or a loose wire or bad soldering joint in the wiring associated with the tube might also be the trouble.
2. **Defective high-voltage rectifier or associated components and circuitry.** Change bad part. END



The Old Timer and the Young Ham fix some TV sets while the Young Ham learns something about customer relations

The CUSTOMER is RIGHT!

By JACK DARR

THE Old-Timer came out of the door of a neat ranch-type, accompanied by the Young Ham with the tube caddy. The two were followed onto the porch by a pretty woman in a housedress and a cute teenager in bright pink Bermuda shorts. The Old-Timer tipped his cap to the lady and said, "Well, there you are, ma'am. Sure hope it works to suit you. If it doesn't, please let us know immediately."

"Yes, I will, dear," said the woman, throwing her arms around the Old-Timer's neck and kissing him soundly. This was repeated by the teenager. The Young Ham puckered up and thrust his face forward also, but received only a smart slap in the face from the young girl. "Well, 'bye now," said the Old-Timer, trotting off down the walk. The Young Ham followed, rubbing his cheek.

As they got into the little black panel truck, the Old-Timer was still grumbling. "That's a dirty trick! You did that! Putting my own address down on the service-call sheet and then keeping me so busy arguing with you that I didn't know where it was until we were on the porch!

The Young Ham grinned at him. "Don't look at me! It was all your wife's idea. She called me at the shop this morning and fixed it up. She said that if she didn't get that set fixed before the kid's favorite program came on this afternoon, she didn't know what she'd do and this was the only way she could get you to work on it!"

"Well, I *was* gettin' kinda tired of that vertical jittering, at that," grinned the Old-Timer. "That oughta ease up on some of the QRM around the house in the evenings, anyhow. Guess that's like the shoemaker's children that are always going barefoot, huh?"

"Sure! TV man never has time to fix his own set. Where are we going now?"

"Where's your dern job list?" asked the Old-Timer. "Oh, here it is. I was sittin' on it. Old man Burns. Right down here a block or two."

"Oh gosh! Not him again!" groaned the Young Ham.

"Yep, him," said the Old-Timer. "Here we are now." The truck pulled up in front of a small white house and they got out. The door was opened by a chunky old man with a fringe of snowy hair around a red face. He greeted them warmly, and they went into the living room where a 21-inch TV set displayed an amazing pattern—the pictures floated up, down and sidewise, all at the same time. The old man pointed to it and said in a high voice, "There she is. See? I left it on so's you could see what it was doing."

"Fine. Thank you," said the Old-Timer, pulling the set away from the wall and beginning to remove the back.

"Looks like a tube, eh? Tuner tube, I'll bet a cookie. Looked at them symptoms and said to myself, 'That's a tuner tube.' How about it? Think it's a tuner tube?" chattered the old man. The Old-Timer agreed with him and continued removing the back of the set. Plugging in the cheater cord, he thumped several tubes. "Hand me a 6U8, willya?" he asked. The Young Ham fished the tube from the caddy and gave it to him. He reached into the set and pulled the old tube. "Ouch! These little stinkers sure do get hot!" he complained, plugging the new tube in. As it warmed up, the picture steadied and snapped into place. The Old-Timer came around in front of the set and checked the range of the hold controls.

The owner, meanwhile, had kept up his steady stream of advice, comments and suggestions, mostly concerned with the "tuner tube." The Old-Timer politely answered each time he paused for breath. He checked the set on each channel; pictures were sharp and clear, and he grunted in satisfaction.

"There. That oughta do it." The Old-Timer replaced the back and tossed the cheater cord to the Young Ham. "Looks fine now. When did this happen, this morning?"

"Yep, sure did," said the old man. "Picture just started floatin' off in all directions all of a sudden. Said to myself right then and there, that's a tuner tube! I remember my son-in-law's set acted just like that once, and he told me it was a tuner tube. Thought I recognized the symptoms."

"Yes, sir, you can sure tell when one of those goes out." He figured out the bill, filled out the job ticket, the old man paid him and they left him, chattering agreeably.

As they rounded the corner, the Young Ham wiped imaginary sweat from his forehead and cried, "Whew! What a blast! If it was wintertime, he could heat the house with all that hot air! I don't see how you put up with

it! He drives me nuts!"

"Junior, that's not a drive; that's a short putt!" said the Old-Timer, straight-faced. "Besides, if old man Burns was the worst customer we had, we'd be doing fine!"

"But all that chatter! And a 'tuner tube!' He wouldn't know a tuner tube from the picture tube!"

It makes him happy?

"Junior!" said the Old-Timer severely. "It's his set, and he paid me for the tube. If it makes him any happier to think that he diagnosed the trouble correctly, who am I to tear down his playhouse? Besides, it ain't nice to poke fun at people. Chances are you wouldn't look too good if you tried your hand at his specialty, which happens to be accounting! That ol' boy was one of the smartest CPA's in this town, before he retired last year! I'd like to see *you* balance a set of double-entry books! My wife don't know too much about TV, but did you ever taste an apple pie that *I* baked?"

"No, and I hope I never do," said the Young Ham.

"Good. I hope so. Point is, you gotta do some things that look a mite silly, now and then, to keep your customers happy. Happier they are, the longer they'll be with us. Longer they're with us, th' happier *we* are!"

"That's so, but some people get on my nerves," said the Young Ham. "Especially when they hang over me when I'm workin'."

"Well, sir, you've just got to get used to a certain amount of that," said the Old-Timer philosophically, "because you're gonna git it. And after all, you can't blame the customers for wantin' to know what's goin' on. It's their sets. They paid a lot of money for the dern things, and they want to know what you're doin' with 'em. Besides, I know a certain character with a flat-top haircut that's pretty much the same way whenever he sees a new process or gadget!"

"Aww! It's different with me. I'm goin' to be an electronics engineer. I'm naturally interested in new equipment and stuff."

"So are the customers," said the Old-Timer, "electronics engineers or not. Junior, that's simply a manifestation of the most human of all traits. Curiosity! Did you know that that accounts for all the progress this world's made? Curiosity! Guy wants to find out how somethin's made and then he wants to find out if there ain't a way it can be made better! So, curiosity's a great thing, applied in the right direction."

"Well, you're right there," admitted the Young Ham. "I never thought of that."

"Speakin' of curiosity," said the Old-Timer, "I'm gettin' a mite curious about something myself."

"What's that?"

"Where in the heck we're goin'!" said the Old-Timer. "We've been drivin' down this street for quite a while now, arguin', and it seems to me like it'd be a good idea if we found out where we was supposed to be!"

"Here's the list. I was sittin' on it this time," said the Young Ham. "Doc Williams. Mrs. Thompson."

"Well, we passed Doc's house some time ago," said the Old-Timer. "Let's see. Let's take Mrs. Thompson's set now, and then get Doc on the way back. Right around the corner here I think." He wheeled the little truck to the left at the next intersection and announced, "Yep. There it is, right over there."

This set's out again!

They pulled up in front of a duplex apartment, got out and rang the bell. They were greeted by a middle-aged woman with a very suspicious look on her face. Curtly, she invited them in. As they came into the living room, she began. "This TV set's out again! It hasn't been over two weeks since you worked on it, and now it's doing the same thing again!"

The Old-Timer went to the TV set and pulled it away from the wall. "Well, now," he said sympathetically, "that's too bad. Let's see what the trouble is. When did it happen, and what's it doing now?"

"Nothing!" snapped the woman. "Not a thing!"

"Is there any sound?" asked the Old-Timer calmly, continuing to dissect the set.

"Yes, the sound's all right, but there's no picture at all and that's what happened last time! I thought you guaranteed your work! If you can't do better than that, we'll have to call someone else next time!"

"Well, we'll soon see what it is," said the Old-Timer, kneeling behind the set. He gave a warning shake of his head at the Young Ham, who was getting very red in the face. Plugging in the cheater cord, he turned the set on. Sure enough, the screen remained dark although the sound came in clearly. He flipped the doghouse lid open, pulled an arc from the tube plate cap, and replaced the 1B3 tube. When he replaced the cheater cord, the screen lit up brightly. The picture was out of sync in all directions, but a few turns of the hold controls fixed that. The Old-Timer squatted on his heels in front of the set, checking the controls. The housewife continued to glare at him with a very sour look on her face.

"There it is," said the Old-Timer cheerfully, checking the set on all channels. "Looks better, doesn't it?"

"Yes," grudgingly admitted the woman, "but how long will it last?"

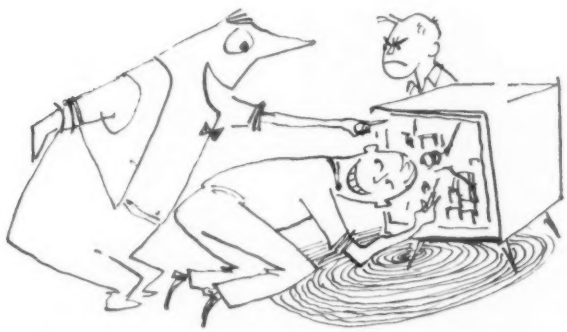
"Gosh, lady, I couldn't tell you and neither could anyone else." The Old-Timer grinned. "Nobody's ever been able to figure out how long any given tube'll last! That tube I just put in may go out tomorrow or it may last for years! That's why we guarantee our new tubes. Once in a while we do find a new tube that goes bad within a few days, even though we test them before we install 'em. If we do, we'll cheerfully replace it, absolutely free. That's why we keep a record of every tube and part we replace in your set; so that we can tell if one of 'em goes out within the warranty period. See here," and he pulled a pack of job cards from the tube caddy. "Here's your set, and here's the last call we made. Replaced this little tube right here." He turned the set around so that she could see into the open back. "See?" pointing to the second video if tube, "where we wrote the date on the chassis, to save lookin' it up? Now, I'll date this one," and he pulled a grease-pencil from his pocket, to write the date on the doghouse in heavy black letters. "What's today?"

"The 5th," said the Young Ham.

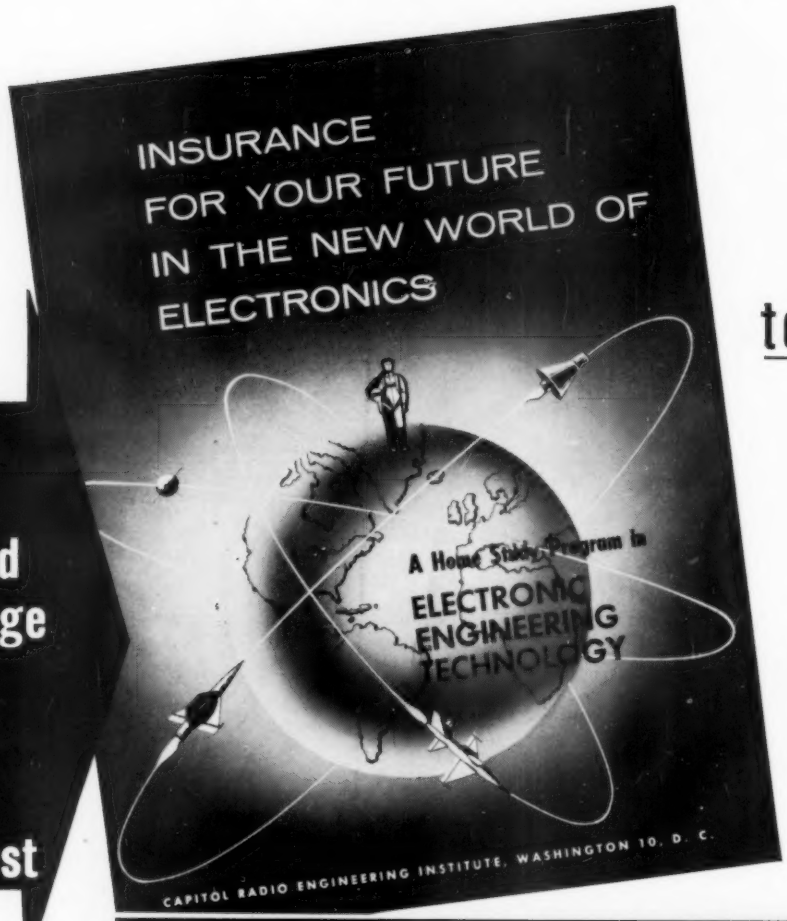
"Thanks. There. Now if that tube goes out within 90 days, you just let us know and we'll replace it without charge. You see, our distributor replaces them for us when they go out within the warranty period so we're not out anything except the time it takes and we don't mind that, much. That's why we buy only the best tubes we can get. If we used cheap tubes, we'd be running all the time replacing 'em!" and he grinned at her. The woman, meanwhile, had studied the service record card carefully and the very obvious date on the chassis. "My," she finally said, "was it that long ago since you were here? I thought it was just a couple of weeks!"

"Well, lots of folks do that," said the Old-Timer, "and we can't remember ourselves half the time when it was

(*Continued on page* 96)



YOUR FUTURE MAY REST BETWEEN THIS PAGE AND THE NEXT!



This Fact-Packed 54-Page Book FREE on Request

use the prepaid post card to send for the data that has launched thousands of careers in...

ELECTRONICS

INCLUDED: *information about CREI's*

BRAND-NEW home study course in

AUTOMATION

and industrial ELECTRONICS engineering technology

- Machine Control Systems
- Data Processing Systems
- Instrumentation Techniques
- Digital & Analogue Computers
- Servo-mechanism Systems
- Telemetry
- Industrial Processes

IMPORTANT!

Fill out and mail this Postage-Free card today
(attached below)
for your copy
of the fact-packed
CREI 54-page book

First Class
Permit No. 288-R
Washington, D. C.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in United States

Postage Will Be Paid By

CAPITOL RADIO ENGINEERING INSTITUTE

3224 SIXTEENTH STREET, N.W.
WASHINGTON 10, D. C.

3-282-7

NOW! NEW COURSE ADDED TO CREI's VARIETY OF COURSES

Brand New Home Study Course

AUTOMATION

And Industrial Electronics Engineering Technology

FOR FULL DETAILS, CHECK THE APPROPRIATE LINE IN THE COUPON BELOW.

Complete home study course, covering all phases of automation with special emphasis on the theory, functioning and applications of servomechanisms and computers. Also noteworthy are lessons on machine control, instrumentation, data-processing, and telemetry. A "must" for engineers and technicians seeking to enter this fascinating branch of electronic technology. Includes fundamentals of electronic engineering technology, leading to specialization in:

• Machine control systems • Digital and Anologue Computers • Data processing systems • Servomechanism systems • Instrumentation techniques • Telemetry systems • Industrial processes

MAIL THIS COUPON FOR FREE 54-PAGE BOOK!

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula • Founded 1927

Dept. 1410-F1 3224 Sixteenth St., N.W., Washington 10, D. C.

Please send me your course outline and FREE 54-Page Book "Insurance for Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Practical Electronic Engineering Technology.

CHECK FIELD OF GREATEST INTEREST

- ☐ Radar, Servo and Computer Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Broadcast (AM, FM, TV) Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology

Name..... Age.....

Street .....

City..... Zone..... State.....

Check: ☐ Home Study ☐ Residence School ☐ Korean Veteran

TO OBTAIN FAST, IMMEDIATE SERVICE AND TO AVOID DELAY, IT IS NECESSARY THAT THE FOLLOWING INFORMATION BE FILLED IN:

EMPLOYED BY .....

TYPE OF PRESENT WORK.....

EDUCATION: YEARS HIGH SCHOOL.....**OTHER**.....

ELECTRONICS EXPERIENCE .....

established scholastic and business standards for the technical school field. We were among the first three technical institutes whose curricula were accredited by the Engineers' Council for Professional Development. In 1946 we instituted the group training programs now used by companies which represent the cream of the electronics and aviation industries.

What does this record of achievement mean to you as a CREI student? It means that industry and the Armed Services alike respect CREI men. It means that your CREI diploma is a door-opener. Significantly, Help Wanted ads often specify "CREI education or equivalent required." Our Placement Bureau, which helps graduates and advanced students find more desirable positions, is always available to CREI men. While no placement guarantees will be made by CREI or any other reputable institution, for many years the demand for CREI graduates and advanced students has far exceeded the supply.

CREI HOME STUDY ADVANTAGES. Technical education is accomplished on your own time, during hours chosen by you. You waste no time in travel. You have plenty of time to do your best. Your work is under the supervision of a regular staff instructor who guides your progress step by step. Courses are prepared by experts, presented in easy-to-understand form, kept up to date by periodic revision. Experience in more than three decades of home-study teaching, during which time we have corrected and commented on many hundreds of thousands of examinations, enables us to anticipate questions in our lesson material and minimize troublesome points.

CREI STUDENTS are professional electronics engineers and technicians, all over the world and in every phase of electronics, about one-third military, the rest civilian. Their median age is 28. Last year they devoted approximately 1,572,456 hours to 104,831 lesson texts, answered (and were individually graded upon) 1,048,310 searching questions and engineering problems. They studied electronics engineering technology—transistors, microwaves, forward scatter, computers, servomechanisms, radar, electronic navigational devices, and the entire field of modern electronics. New students enrolled during the year are on the missile ranges of Vandenburg AF Base and Cape Canaveral. They are at Alamagordo and China Lake, at SAC bases around the world. They are in the research laboratories and manufacturing plants where the latest electronic equipment is designed and produced. They maintain electronic equipment for United Air Lines, and Trans-Canada Air Lines. They share in electronics at All America Cables and Radio, Inc., and The Martin Co. They work for USIA (Voice of America) and Columbia Broadcasting System, for Gates Radio and Federal Electric, to name but a few. All of the firms mentioned offer their personnel CREI technical education under company plans. CREI men are found by the hundreds among field engineers of major electronic manufacturers. They're across the world and across the street. They're men you'll compete with—to gain or hold your place in the electronics profession.

QUALIFICATIONS FOR CREI. College degree is not essential. If you have had basic electronic

education, practical experience in electronics, and a high school education, you can probably qualify. A good way to find out: Use the postage-paid card. It will bring you the free 54-page book which has launched thousands on their advanced careers: "Insurance for Your Future in the New World of Electronics." Tuition is reasonable and may be paid monthly. It takes just one $10-a-week raise to repay your investment in CREI education and leave you a substantial bonus the first year. Available to veterans under GI bill.

LATEST CREI COURSE: Now added to CREI's variety of courses in Electronic Engineering Technology is *Automation and Industrial Electronics Engineering Technology.* Complete course covering all electronic phases of automation. Special emphasis on theory, functioning and applications of servomechanisms and computers. Also noteworthy—lessons on machine control, instrumentation, data processing and telemetry.

RESIDENCE SCHOOL in Washington, D. C. for those who can attend classes. Day and evening classes start at regular intervals. Qualified graduates earn AAS degree in 27 months. Electronics experience not required for admission.

CAPITOL RADIO
ENGINEERING INSTITUTE

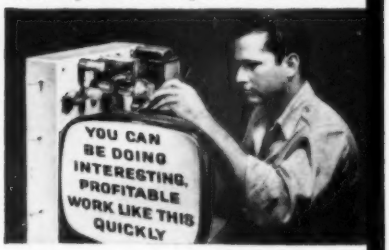
ECPD Accredited Technical Institute Curricula Founded 1927

Dept. 1410F1 **S[1]**
3224 16TH ST., N.W.
WASHINGTON 10, D. C.

COYNE offers LOW COST TELEVISION Training in Spare Time AT HOME

The future is YOURS in TELEVISION—RADIO COLOR TV!

A fabulous field—good pay—fascinating work—a prosperous future! Good jobs, or independence in your own business!



Coyne brings you MODERN—QUALITY Television Home Training; training designed to meet Coyne standards. Includes **RADIO, UHF** and **COLOR TV.** No previous experience needed. Practical Job Guides to show you how to do actual servicing jobs—make money early in course. You pay only for your training, no costly "put together kits."

Send coupon or write to address below for FREE Book

and full details including easy Payment Plan. No obligation, no salesman will call.

Coyne — the Institution behind this training . . . the largest, oldest, best equipped residential school of its kind now in its new home pictured here . . . Founded 1899.

B. W. Cooke, Jr., President

COYNE ELECTRICAL SCHOOL

1501 W. Congress Pkwy., Chicago, Dept.79-H5

Chartered as an Educational Institution Not For Profit

COYNE Television, Home Training Division
Dept.79-H5-New Coyne Building
1501 W. Congress Pkwy., Chicago 7, Ill.

Send Free Book and details on how I can get Coyne Quality Television Home Training *at low cost and easy terms.*

Name_____

Address_____

City_____ State_____

(It is understood no salesman will call)

TELEVISION

(*Continued from page* 91)

we did a certain job. That's why we keep up these records. That's the only way we can be sure you're getting your money's worth!" He smiled at her. This time the smile was returned.

Thawing perceptibly, she asked, "That's a pretty good set, isn't it?"

"You bet it is," said the Old-Timer enthusiastically. "That's one of my favorite makes. They're well built and they've been giving good service around here. We like 'em because they're easy to work on, too."

"Well," said the housewife, "thank you for coming over so quickly. My husband would be in a terrible temper if he missed that fight tonight!"

"I'll bet he would!" agreed the Old-Timer. "I would, too. That's gonna be a good one, and I want to see it myself. If my set won't work, how about comin' over and watching it here?"

The housewife laughed heartily and invited him over, if it became necessary, which the Old-Timer gravely assured her that it might. She asked how much the bill would be.

The Old-Timer fished a battered price list out of his well-packed shirt pocket. "Lessee. 1B3—$2.40, service—$4.50 Total, $6.90." He filled in the job card.

"I'll make a note of it here," reaching for the telephone scratch pad, "and my husband will write you a check tonight when he gets home."

"Thank you, ma'am, that'll be fine," said the Old-Timer, picking up the tube caddy. They hopped into the truck and left. Once safely out of sight, the Young Ham exploded.

"Of all the unreasonable people! Wow! That woman's the worst I ever saw! Why, she didn't have any reason for being so mad at us! Two weeks ago! I saw the date on the chassis, and it was over two *months* ago! I saw it!"

"*She* did too, Junior," grinned the Old-Timer. "Why do you think I turned the set around so she could see in the back after I gave her that job card? Notice how she kinda began to cool off right after that?"

"Well, you've certainly got a lot of control over your temper," said the Young Ham. "I'd have told her where she got off *so* quick! You just sat there and took it!"

Gotta put up with it

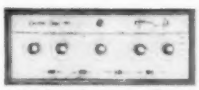
"Young sprout, lemme tell you about the birds an' bees of business life," said the Old-Timer. "You're gonna have a certain amount of that stuff to put up with and when you've been around as long as I have you'll learn to not let it bother you. She was just blowin' off steam, that's all. And, still more important, if you argue with 'em, you not only get 'em madder, you make 'em more firmly convinced that they're right! What good is winning an argument if you lose a customer? Let them have a chance to cool off; to find out that they're wrong and give 'em a chance to back down gracefully, like I gave Mrs. Thompson. Soon as she

maybe you've seen such quality before but never at these low prices

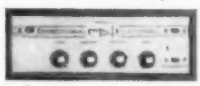
SONIC

STEREO COMPONENTS

Engineered by one of the nation's foremost independent phonograph manufacturers. These new high fidelity stereo components represent this firm's vast engineering and experience.



SONIC CUSTOM-CRAFT S-200 12 watt stereo, master control center and dual amplifiers. 6 watts per channel develops 24 watts of peak power. Frequency response, ± 1.5 db from 50 to 15,000 cps. Total harmonic distortion, less than 2% at full rated output. Stereo or monophonic inputs. Internal audible stereo test signal for channel and speaker balance adjustment. 9 separate front-panel controls. 4, 8 and 16 ohm ouputs for single, double, or triple channel operation.
audiophile net with enclosure **$49.95**



SONIC CUSTOM-CRAFT S-100 low-priced hi-fi 10 watt stereo, master control center, and dual amplifiers. 5 watts per channel develops 20 watts of peak power. 50 to 15,000 cps response with less than 5% of total harmonic distortion at full rated power. Hum and noise, 45 db below maximum rated power. 4 stereo or monophonic inputs. 8 ohm outputs for single or double operation.
audiophile net with enclosure **$34.95**

SONIC CUSTOM-CRAFT MODEL 19 FM-AM TUNER Super-sensitive tuner features drift-free automatic frequency control performance and 3-gang tuning capacitor for optimum selectivity. Sensitivity-FM 5 μv for 30 db quieting. Total harmonic distortion at rated output, less than 1.5%. Selectivity bandwidth at 6 db point: FM 200 kc, AM 9 kc. Frequency response, FM ± 2 db of standard de-emphasis curve, AM 20 to 9,000 cps. Function switch AM, FM or FM-AFC.
audiophile net less cabinet **$79.95**
MODEL 19C with handsome mahogany cabinet.
audiophile net **$99.95**

SONIC CUSTOM-CRAFT S-400 (pictured above) Quality combination 40 watt stereo amplifier, master control center, and transistorized preamplifier. 20 watts per channel delivers 80 watts of peak power. Frequency response, flat from 20 to 20,000 cps ± 0.5 db. Less than 1% total harmonic distortion at full rated output. Built-in stereo test signal to adjust channel and speaker balance as well as speaker phasing. Sonic Stereo Monitor, a precision meter shows when both channels are properly balanced. 8 inputs and 9 front panel controls handle any program source. 4, 8 and 16 ohm outputs for single, double or triple channel operation. audiophile net with enclosure **$99.95**

at your local hi-fi dealer, or write RE-10

SONIC INDUSTRIES, INC.

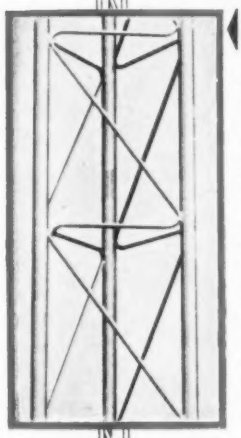
19 Wilbur Street, Lynbrook, N. Y.

LOOK TO ROHN

for ALL TV installation needs!

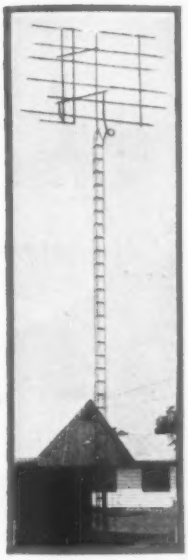
LOOK TO THE FOREMOST NAME IN THE COMPLETE LINE OF HOME TV, AMATEUR AND COMMUNICATION TOWERS, PLUS A COMPLETE LINE OF INSTALLATION NEEDS. You'll find that the ROHN line is *complete*. It gives you *better* products at a *better* price. Practically all ROHN products are available in the finest of finishes . . . *hot-dipped galvanizing!* Rely on the *dependable* name for ALL your needs —ROHN . . . today one of the largest manufacturers of a *complete* line of this type equipment.

TOWERS



No. 25 The ROHN No. 25 tower is one of the finest ever designed . . . a full 33% stronger and more durable than "similar sized" towers. This is achieved by amazing zig-zag cross bracing design combined with highest grade steel and heavy-duty steel side-rail tubing. This superior strength means that this tower can ordinarily be installed self-supporting to 50 feet or guyed to 200! It is truly the *finest* tower of its kind for home television reception.

No. 6 This ROHN tower features the well-known "magic triangle", the cross-bracing construction that is unequalled in strength and durability. Also available self-supporting, or guyed to about 150 feet.



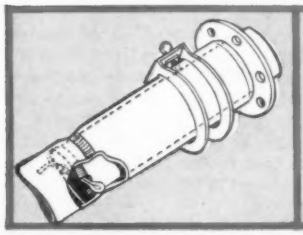
Fold-over The No. 25, as well as heavy-duty No. 40 communication tower, can be converted into "fold-over" towers for amateur use . . . the *only* tower of its kind. They let you work "on the ground!"

Communications

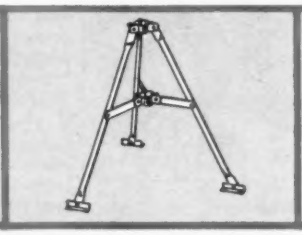
FIVE complete lines of communication towers are available to fulfill *practically any need*, including a 130 foot true heavy-duty communication tower that is completely self-supporting and guyed models up to 600 feet!

Complete communications catalog sent on request!

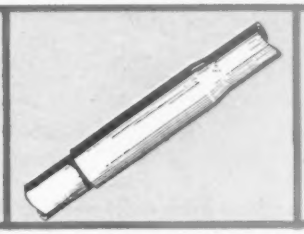
PLUS ALL THESE ROHN DESIGNED ITEMS



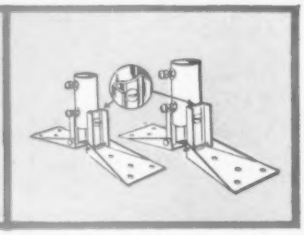
Telescoping masts—Unexcelled in design, structure and strength, with several exclusive features! All popular sizes, heights and weights available.



Roof towers—Available in 10, 5 and 3 foot heights. Most of them are collapsible for easy shipping. Ideal in use—a ROHN "big-seller".



Tubing—Just what you want: 6" expanded end with ½" taper to form a solid locking joint! High carbon steel. Available 5, 10 foot lengths, 1¼", 1½" diameter, 16 and 18 gauge.



Bases—Wide variety of roof mount bases. Special locking feature. Also available is cast aluminum roof mounts and many other types.

Get the full and complete catalog from your ROHN representative.

ROHN *Manufacturing Company*

116 LIMESTONE, BELLEVUE
PEORIA, ILLINOIS

ROHN Manufacturing Company
116 Limestone, Bellevue
Peoria, Illinois

Please send me literature on full line of ROHN products.

Firm _____

Name _____ Title _____

Address _____

City _____ State _____

12% TO 15% LESS ATTENUATION!

polyfoam

RG-8/U TYPE CABLE

DESCRIPTION

AMPHENOL introduces a new polyfoam dielectric coaxial cable equivalent of RG-8/U but with a significant reduction in attenuation. Part number is 621-111.

ELECTRICAL AND MECHANICAL CHARACTERISTICS

Impedance—50 ohms ± 2 ohms
Attenuation—4.0 db/100 feet nominal at 400 mc.
Dielectric Strength—5000 V. RMS
Corona—3000 V. RMS
Capacity—26.0 mmf/ft. nominal
Overall Diameter—.405" ±.010"

FEATURES

From 12% to 15% less attenuation than standard RG-8/U.
Lower capacity than solid dielectric 50 ohm cables.
Used with standard UHF Series connectors.

AVAILABILITY

Contact your local Authorized AMPHENOL Distributor!

AMPHENOL *distributor division*

AMPHENOL-BORG ELECTRONICS CORPORATION
broadview, illinois

found out what the score was she cooled off, didn't she?"

"Yes, but she acted like it hurt her," said the Young Ham.

"Well, it hurts to admit you're wrong anyhow, don't it?"

"Yes, it does," admitted the Young Ham, remembering an argument he'd lost to the older man the day before. "Especially if you're convinced you're right!"

"Well, all's well that ends well, and that's a lot of wells. Speakin' of ending well, lemme warn you about something right now. You're gittin' a habit of kinda arguin' with th' customers in th' shop, and I'd rather you didn't. If they git uppity, just holler for me, and I'll take 'em on. But, you just remember this, young feller. Don't let me catch you bawlin' out any customers around *my* shop, or you'll regret it! The rule of this here establishment is patience and politeness, no matter what a customer says to you!"

"For gosh sakes', what are you supposed to do?" said the Young Ham in an aggrieved tone. "Just stand there and let 'em bawl you out?"

"That's just about the idea," said the Old-Timer. "Let 'em git it off their chest before you say too much. You've got to consider one indisputable fact: when a person calls us, you know they're *in trouble!* We're just like doctors. We never see anybody when they're in good health! Unless they're in trouble they don't call on us at all! So they're pretty apt to be in a bad humor before they ever git to us, and we've got to handle 'em with kid gloves until we can git 'em cooled off. Any little remark at th' wrong time can set 'em off like a firecracker! So it behooves us to walk pretty softly and not say too much until we find out what the score is. In the meantime, if they want to blow off steam, let 'em; just kinda let it go in one ear an' out th' other!"

"That's awful hard to do sometimes," complained the Young Ham.

"Yeah, I know, but you might as well begin learnin' to do it. If you're going to be in any kind of business dealin' with th' general public, you're gonna have to learn that skill first! There's two things you've got to learn if you're gonna be a successful TV technician, and only *one* of 'em is learnin' how to fix TV sets! The most important one is learnin' how to handle *people!*"

"Me, I'd rather have the TV sets," said the Young Ham.

"Sometimes I would too," admitted the Old-Timer. "But, howsomever, you'll find that there's only about 5% of your customers that ever give you much trouble, thank goodness. The rest of 'em are just as nice and obligin' and reasonable as they can be. It's that 5% that gets the most attention though. They're the ones that give you all the trouble! Unfortunately, there's a law against poisonin' 'em!"

"Maybe we could get it repealed, huh?" asked the Young Ham. END

ELECTRONICS

Danger!

Some electron tubes are radioactive!

By EDMUND H. MARRINER

SOME of the everyday tubes used in receivers and transmitters contain radioactive materials. The more common of these are regulator tubes—the 0A2 and 0B2. Caution in handling cannot be overemphasized.

The danger is similar to that experienced with early fluorescent lamps. When intact, bulb unbroken, there is no real hazard. The amount of radioactivity is below the level that is considered dangerous. But should the bulb be broken, the radioactive material (cobalt 60 and nickel 63) may be picked up and get into your body—through breathing, eating, drinking or wounds in the skin. These radioactive isotopes — they emit alpha, beta or gamma particles—can injure or destroy blood-forming organs and other tissue. Internal radiation of this type may show up in a few weeks or it may take a few years, because the material fixes itself in the tissue, and its removal from the body is very slow.

If you should break one of these tubes, remember:

- Don't let any part of the broken tube touch the body. Use rubber gloves.
- Don't bring any food or drink into the contaminated area.
- Wash thoroughly.

Also, since these tubes can be dangerous, don't let children play with old ones, or break them open to see what's inside.

A detailed listing of all tubes that contain radioactive substances can be found in the *Bureau of Ships Journal* for December 1957, published by the Department of the Navy. Aside from the regulator tubes—that section of the listing is presented here—only uncommon types are found (microwave, radar, special-purpose). However, some of these are extremely dangerous, containing much larger amounts of radioactive isotopes. Some have to be marked with a seal showing that they are radioactive, and special disposal precautions must be taken. But the only types you are likely to encounter are regulator tubes. The table shows a listing of these units as shown in the *Journal*. END

Type	Manufacturer	Isotope	Amount (microcuries)
0A2	Raytheon	Cobalt 60	.0067
0A2-WA	CBS-Hytron	Nickel 63	.01–.05
0A2-WA	Raytheon	Cobalt 60	.0067
0B2	Raytheon	Cobalt 60	.0067
0B2-WA	CBS-Hytron	Nickel 63	.01–.05
0B2-WA	Raytheon	Cobalt 60	.0067

HANDLE ANY Radio-TV SERVICE JOB

easier...better...faster

with these professional methods

Let these two famous training books teach you to handle all types of AM, FM and TV service work by approved *professional* methods . . . then watch your efficiency and earnings soar! Almost 1500 pages and over 800 clear pictures explain every troubleshooting and repair operation as clearly as A-B-C. Throughout, you get down-to-earth training that teaches you to do the best work in the shortest time. Each book is co-authored by A. A. Ghirardi whose radio-electronic training books have, for more than 25 years, been more widely used for military, school and home training than any others of their type. See money-saving offer!

1 RECEIVER CIRCUITRY & OPERATION

Circuit "know how" eliminates useless testing and guesswork!

Ghirardi's 669-page Radio & TV CIRCUITRY AND OPERATION brings you above-average training that takes the headaches out of troubleshooting—helps you work better and faster—gives you a far better understanding of the technical details of modern equipment. Explains basic circuits—teaches you to recognize them—shows what troubles to look for and where to look—how to eliminate useless testing. Even covers circuit servicing problems in home recorders, pickups and record players, record changers and radio-TV set mechanical servicing details. Price $6.75 separately—or see money-saving offer in coupon.

2 TROUBLESHOOTING AND REPAIR

The manual that really shows you how!

Ghirardi's 822-page Radio & TV TROUBLESHOOTING AND REPAIR manual is a down-to-earth guide to locating and repairing anything likely to go wrong with home entertainment electronic equipment. For beginners, it is an easily understood course in professional methods. For experienced servicemen, it is ideal for developing time-saving techniques or finding fast answers to problems. All types of testing and repair are clearly explained. Special step-by-step charts cover TV troubles, AM or FM realignment, IF detector and car radio troubles and other tough jobs. Teaches you to work by approved *professional* methods. Price $7.50 separately. See money-saving offer.

SAVE $1.25

If broken into "lessons" and sold as a "course" you'll regard these famous Ghirardi books as a bargain at $100. Instead you get BOTH at only $13.00 (a $1.25 saving over buying them separately)!

PRACTICE 10 DAYS FREE!

Dept. RE-109, RINEHART & CO., Inc., 232 Madison Ave., New York 16, N. Y.

Send books checked for 10-day FREE EXAMINATION. I will then either remit price indicated (plus postage) or return books and owe nothing.

☐ CIRCUITRY & OPERATION.....$6.75 separately

☐ TROUBLESHOOTING & REPAIR.....$7.50 separately

☐ MONEY-SAVING COMBINATION.....Save $1.25

Send both books at only $13.00 for two (regular price $14.25). Payable at rate of $4 (plus postage) after 10 days and $3 a month thereafter until $13 has been paid. (*SAVE! Send $13.00 with order and we pay postage. 10-day money-back guarantee.*)

Name.....

Address.....

City, Zone, State.....

OUTSIDE U.S.A. Add 50¢ to price of each book, $14.00 for the two. Cash with order only; same 10-day return privilege.

Superior's New Model 82A

Multi-Socket Type TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

(1) **Turn the filament selector switch to position specified.** (2) **Insert tube into a numbered socket as designated on our chart (over 600 types included).** (3) **Press down the quality button —**

THAT'S ALL! ***Read emission quality direct on bad-good meter scale.***

Model 82A—Tube Tester. Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

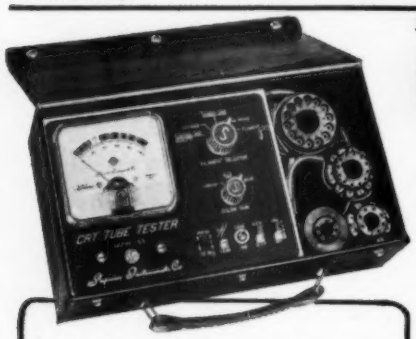
To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch — THAT'S ALL! Read quality on meter. Inter-element leakage if any indicates automatically.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. *Don't let the low price mislead you!* We claim Model 82A will outperform similar looking units which sell for much more —and as proof, we offer to ship it on our examine *before* you buy policy.

SPECIFICATIONS

• Tests over 600 tube types • Tests OZ4 and other gas-filled tubes • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence • Dual scale meter permits testing of low current tubes • 7 and 9 pin straighteners mounted on panel • All sections of multi-element tubes tested simultaneously Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only..... $36.50



SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS AND REJUVENATES ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types—from 8" to 30" types

- Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton in the set!

- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only— **$38.50 NET**

Model 83—C. R. Tube Tester. Total Price $38.50 Terms $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

GENOMETER

7 Signal Generators in One!

- ✓ *R.F. Signal Generator for A.M.*
- ✓ *R.F. Signal Generator for F.M.*
- ✓ *Audio Frequency Generator*
- ✓ *Bar Generator*
- ✓ *Cross Hatch Generator*
- ✓ *Color Dot Pattern Generator*
- ✓ *Marker Generator*

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peak wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency).

THE MODEL TV-50A comes absolutely complete with shielded leads and operating instructions.

$47.50 NET

Model TV-50A—Genometer. Total Price—$47.50. Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

Superior's New MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to *any* peak-to-peak V. T. V. M. made by *any* other manufacturer at *any* price!

- **Model 77 completely wired and calibrated with *all* accessories (including even portable carrying case) sells for only $42.50.**
- **Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.**
- **Model 77 uses new improved SICO printed circuitry.**
- **Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.**
- **Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.**
- **Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.**
- **Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.**
- **AS A DC VOLTMETER:** The Model 77 will measure any voltage up to 1500 volts with negligible loading. It is indispensable in receiver and Hi-Fi Amplifier servicing and a must for Black and White and Color TV Receiver servicing where circuit loading cannot be tolerated. A special feature permits accurate zero center measurements necessary for the true alignment of Foster-Seely (Armstrong) FM detectors, Ratio Detectors and the newer Gated Beam Detectors.
- **AS AN AC VOLTMETER:** The old-fashioned laboratory AC V.T.V.M. was cumbersome, erratic and required several dial manipulations to arrive at a reading. The Model 77 when connected to a circuit will quickly and simply measure its RMS value if sine wave, and its peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers, sync. pulses and saw tooth voltages are easily read with the Model 77.
- **AS AN ELECTRONIC OHMMETER:** Because of its wide range of measurement in the resistance range (from .2 ohms to 1,000 megohms) the Model 77 will be your most frequently used resistance meter. Leaky capacitors which may not show up on other resistance meters, show up glaringly when tested with the new Model 77. Because of its sensitivity and low loading, intermittents are more easily found, isolated and repaired.

Model 77—Vacuum Tube Voltmeter, Total Price $42.50. Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Traditionally, the V. T. V. M. has been the one instrument used for voltage measurements where low-drain or wide frequency resoonse is essential. And now, the Model 77 V. T. V. M. by taking advantage of new developments including modern balanced push-pull circuit design, etched circuitry, an extra large meter and other improvements provides such measurements quicker, with a higher degree of accuracy and with better readability.

The Model 77 will measure DC with negligible loading AC of ANY FORM WAVE; whether sine wave, pulse wave, saike wave, square wave or other comolex wave forms. It will measure all AC from 30 cycles to over 5 megacycles and will do so without additional accessories or cables.

SPECIFICATIONS

- DC VOLTS—0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance
- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1500 volts.
- AC VOLTS (Peak to Peak)—0 to 8/40/200/400/800/2000 volts.
- ELECTRONIC OHMMETER—0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- DECIBELS—10 db to +18 db, +10 db to +38 db, +30 db to +58 db. All based on 0 db=.006 watts (6 mw) into a 500 ohm line (1.73v).
- ZERO CENTER METER—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.....

$42.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C. O. D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. *No Interest or Finance Charges Added!* If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC.
Dept. D-671, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

- ☐ **Model 77.....Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.**
- ☐ **Model TV-50A.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.**
- ☐ **Model 82A.....Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.**
- ☐ **Model 83.....Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.**

Name.....

Address.....

City.....Zone.....State.....

All prices net, F.O.B., N.Y.C.

ELECTRONICS does the COUNTING

People, cars, or packages . . . you can find out how many go by with this compact 1-transistor unit

The combination on–off switch and sensitivity control is on the readout end of the case.

By ELLIOTT A. McCREADY

ELECTRONIC counting devices record a great variety of events: the number of persons viewing displays, the flow of traffic on a city street, objects passing through an assembly line and other occurrences too numerous to mention. The versatility of these devices seems limited only by human imagination.

The simplest electronic counter is electromechanical and operates on the same principle as a stepping relay. Each pulse delivered to the counter actuates a ratchet and advances the unit one digit. Such a device requires a rather sizable pulse of current, so the counter is usually operated in conjunction with a sensitive relay. The trigger pulse that keys the sensitive relay (and in turn the counter) may be generated in a number of ways: pressure switches, capacitance relays and photocells to name a few.

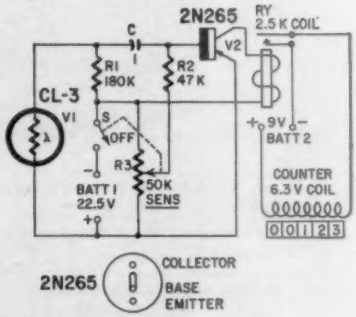
The electronic counter described in this article is small (3 x 4 x 5 inches), light (under 2 pounds) and entirely self-contained and self-powered. Sensitivity is so high that the unit need only be aimed toward a window, lamp or light-colored wall. Just about the only auxiliary equipment required is a shelf or box on which to set the thing.

Counter circuitry

The heart of this electronic counter is an extremely sensitive cadmium selenide photocell, the Clairex CL-3. This photocell is so sensitive that a very small, abrupt variation in light intensity produces a sizable output pulse. This output pulse is amplified many times by a 2N265 transistor (see schematic) which has a beta, or current gain, of *110*. To develop maximum gain and supply the largest possible bias to the photocell, the transistor is operated at close to its maximum voltage rating. Of course, the photocell could be biased separately with a much higher voltage. However, its sensitivity at 22.5 volts is adequate, and the need for a separate battery and switch is eliminated.

A sensitive relay in the transistor's collector circuit responds to each light pulse at the photocell and operates a standard electric counter.

The instrument's maximum counting rate is determined by the top speed at which the relay and counter will respond, and the time constant of R1–C.



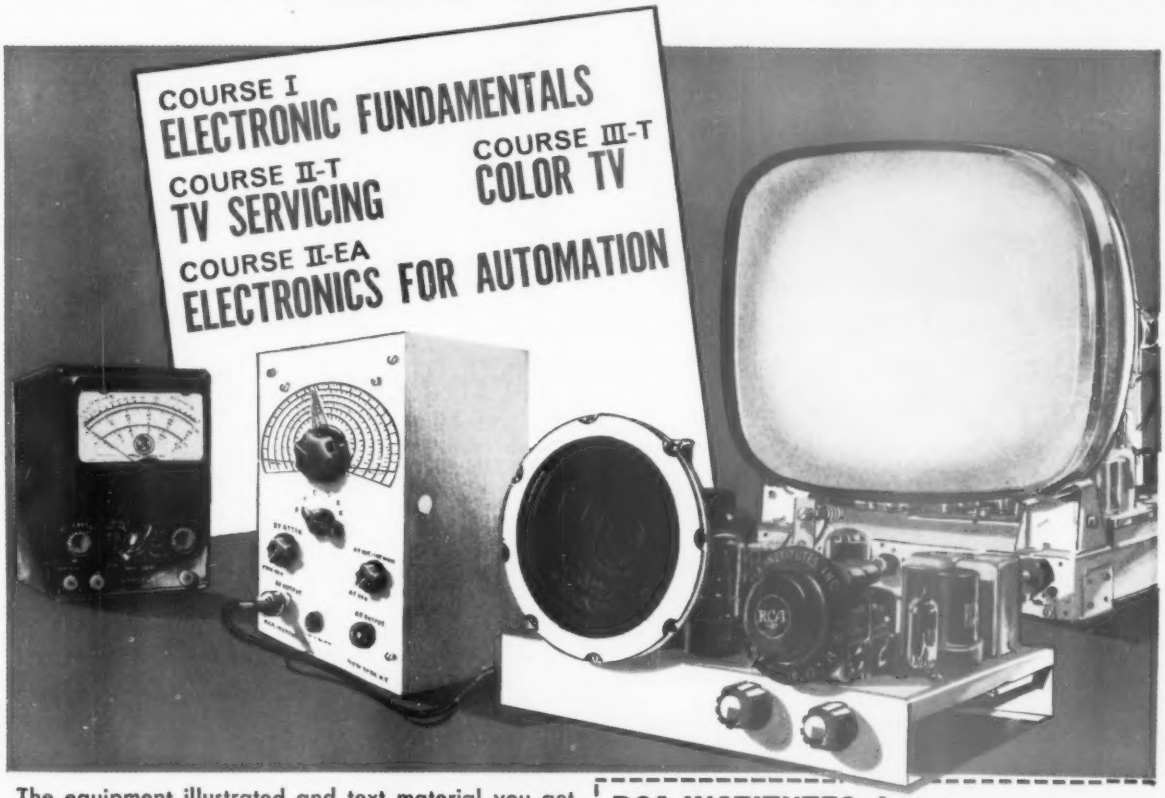
R1—180,000 ohms, ½ watt
R2—47,000 ohms, ½ watt
R3—pot, 50,000 ohms with spst switch
C—1 μf, 200 volts
BATT1—22.5 volts (Burgess U15 or equivalent)
BATT2—two 9-volt units in parallel (RCA VS305 or equivalent)
RY—5-mw sensitivity, 2,500-ohm coil (Sigma 5F-2500-S/SIL or equivalent—see text)
S—spst on R3
V1—photocell, Clairex CL-3
V2—2N265
Counter, electromechanical, 6.3-volt ac coil (Mercury MEA-N5-6A or equivalent)
Chassis box, 3 x 4 x 5 inches
Socket, for transistor
¾-inch threaded control grommet
¾-inch Bakelite control protector cap
Miscellaneous hardware

Circuit of the electronic counter.

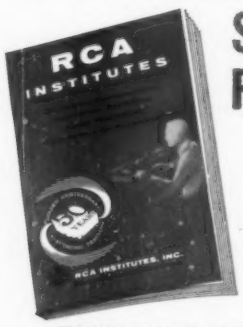
The relay and counter operate at about 10 pulses per second. The time constant (R1–C) was purposely made rather long to develop a large pulse at the output of the photocell. This long time constant results in an overall maximum counting rate of approximately five pulses per second. Shortening the time constant of R1–C by lowering the value of either component will speed up the response of the instrument, but results in lower overall sensitivity.

One thing that may puzzle the reader is the 6.3-volt ac counter. The reason

RCA INSTITUTES OFFERS YOU THE FINEST OF HOME STUDY TRAINING



The equipment illustrated and text material you get with each course is yours to keep. Practical work with very first lesson. Courses for the beginner and the advanced student. Pay-as-you-learn. You need pay for only one study group at a time.



SEND FOR THIS FREE BOOK NOW

Resident School courses in New York City offer comprehensive training in Television and Electronics. Day and evening classes start four times each year. Detailed information on request.

RCA INSTITUTES, Inc. Home Study School Dept. ZRE-109
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N. Y.

Without obligation, send me FREE 64-page CATALOG on Home Study Courses. No salesman will call.

Name.....
Please print

Address.....

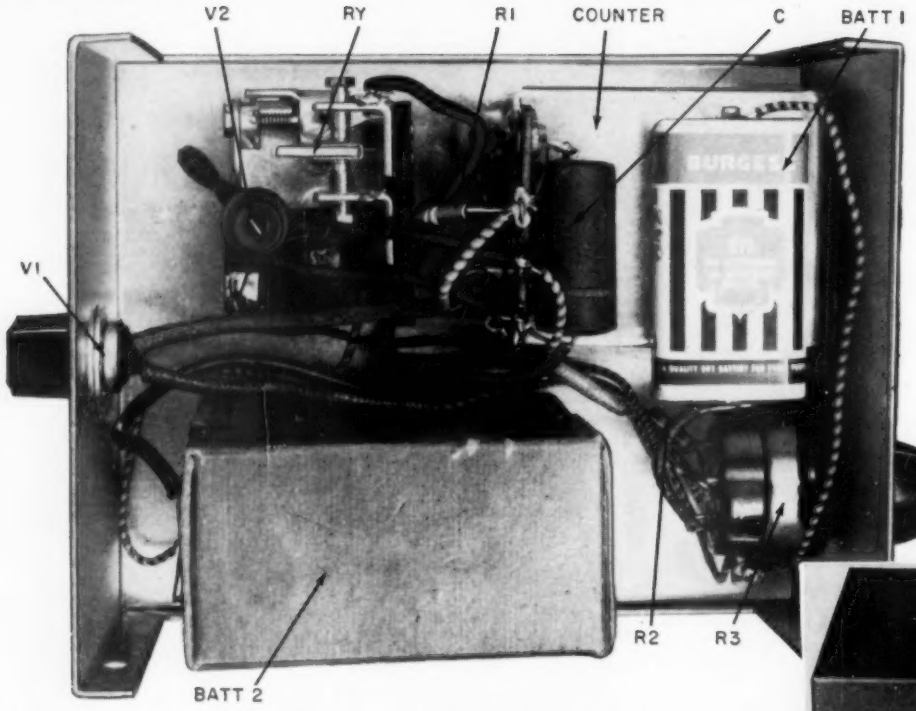
City.....Zone....State.....

Korean Vets! Enter discharge date_____

CANADIANS—Take advantage of these same **RCA** courses at no additional cost. No postage, no customs, no delay. Send coupon to:

RCA VICTOR COMPANY, LTD.
5001 Cote de Liesse Rd., Montreal 9, Que.

To save time, paste coupon on postcard



Under the chassis. For longer life before changing batteries use larger units for BATT2. Of course, this means the case will have to be larger.

Looking like a one-eyed monster (below), this is the business end of the electronic counter.

is that a counter with a dc coil couldn't be found. The ac unit operates very nicely at 9 volts dc. As the counter draws a large amount of current, its power supply (BATT2) is made up of two fairly large 9-volt batteries, parallel-connected.

Parts substitutions

If you are anything like me, you are probably reluctant to buy a new component when you have an almost identical one in the spare-parts box. Here are a few pointers on substituting components used for the counter:

The CL-3 photocell may be replaced with a CL-2 or CL-1, **but sensitivity will suffer.** The CL-3 is about six times as sensitive as either of the other two.

The 2N265 may be replaced with a transistor with like characteristics. I have one or two hand-picked CK722's which perform almost as well as the 2N265.

When substituting relays, several points should be remembered. The life of BATT1 depends on the operating current of the relay. For battery economy, use a sensitive relay.

Construction

The unit is housed in a 3 x 4 x 5-inch, two-piece aluminum chassis. All components are mounted on the flanged portion of the chassis, as shown in the photo.

The two metal tabs on the upper surface of the electromechanical counter are bent horizontal and fastened to the case. A ⅞ x 1¾-inch hole is cut in one end of the chassis for the readout end of the unit.

BATT1 is cemented to the top inside of the counter with service cement. The two units that make up BATT2 are cemented together and the entire battery secured to the chassis with more cement. You may prefer to use a clamp, but space is rather limited.

The photocell is cemented inside a ⅜-inch threaded control grommet (ICA 1250, E. F. Johnson 115-255 or equivalent) and mounted at the front of the chassis. Saw the solid end off a ⅜-inch bakelite protector cap of the type used to prevent tampering with TV back-of-chassis controls (D&M Control Guards) and screw the remaining portion onto the control grommet. This tube extends ½ inch or so beyond the photocell and limits the field of light.

When wiring sensitivity control R3, make sure that clockwise rotation of the control increases the negative bias at the transistor's base.

A miniature hearing-aid socket was used for the transistor. However, it can be soldered directly into the circuit. Just be careful—don't let heat from the soldering iron do any damage. The photocell can also be damaged by heat, and a heat sink should be used when soldering to its leads.

Operation

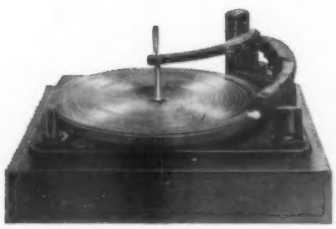
Place the counter so the photocell faces a light source in such a way that objects to be counted will pass between it and the light. As the unit is extremely sensitive, a lamp, window or the light-colored wall of a well lighted room should be adequate light sources.

Switch the instrument on (one count will register). Advance the sensitivity control (R3) until the counter pulls in. Now back off R3 until the counter releases. The unit is now ready to operate, and objects passing between the photocell and light source should register on the counter.

A little experimenting will quickly determine the maximum distance the counter can be placed from the object to be counted. Factors such as light intensity or area, and the size of the object, will vary the effective distance. I have found that, in a normally lighted room, the counter will register when a person passes within 6 feet, if the photocell is directed at a shaded lamp 10 to 12 feet away. Small objects must be closer to the counter to register.

As I stated earlier, the basic electric counter requires a considerable amount of current. For this reason the largest practical batteries (BATT2) were selected to operate the electromechanical counter. After the instrument was completed, over 20,000 counts were registered in fairly rapid succession and the batteries were still going strong. This leads me to believe that one set of batteries should be good for quite some time. BATT1, with only negligible current drain, should approach shelf-life. END

our British cousins at Collaro stress meticulous care and precision engineering in every *Collaro* stereo record player!



The Constellation, Model TC-99—$59.50

The Continental II, Model TSC-840—$49.50

The Coronation II, Model TSC-740—$42.50
*The Conquest II, Model TSC-640—$38.50

Transcription Turntable, Model 4TR-200—$49.50

Manual Player, Model TP-59—$29.95

ROCKBAR Corporation

Every Collaro stereo record player is built with typical British attention to every detail. They are precision engineered and rigidly tested to give truly professional performance and the ultimate in operating convenience. Here are some of the important features that make Collaro the logical choice for stereo or monophonic records. • Performance specifications exceed NARTB standards for wow, flutter and rumble —with actual performance test reports accompanying each model TC-99. • Extra-heavy, die-cast, non-magnetic turntables (weighing up to 8½ lbs.). Extra-heavy weight is carefully distributed for flywheel effect and smooth, constant rotation. • Shielded four-pole motors are precision balanced, screened with triple interleaved shields to provide extra 25 db reduction in magnetic hum pick-up. • Detachable five-terminal plug-in head shells (on TC-99, TSC-840, TSC-740, TP-59) provide two completely independent circuits, guaranteeing ultimate in noise reduction circuitry. • Transcription-type stereo tonearms are spring-damped and dynamically counterbalanced to permit the last record on a stack to be played with virtually the same low stylus pressure as the first. • All units are handsomely styled, available with optional walnut, blond and mahogany finished bases or unfinished utility base. There's a 4-speed Collaro stereo record player for every need and budget! Prices slightly higher in the West. For free catalog on the Collaro line, write to: **Rockbar Corporation, Dpt. RE-10, Mamaroneck, N. Y.** (*Not shown. Similar in appearance to The Coronation.)

RC-13

Relayless alarm circuit is keyed by light, temperature, sound or rf signals

Sensitive Signaling Circuit

By NATHANIEL RHITA

A SENSITIVE relay is generally used when a weak electric signal must set off a visual or audible alarm, turn on a motor or accomplish some kind of control. Such a relay is quite expensive. For example, in the 10–20-μa range, it may cost $30 or more. If the relay is needed only to set off an audible alarm (to indicate that an electrical signal is being received), it may be replaced by a simple transistor circuit.

This transistor device sounds a warning when an 8-μa signal is fed to it. Since it is so easy to convert light, sound, temperature change or rf power into electricity, this unit has unlimited possibilities. For example, a humidity sensor plate can be used to produce the electric signal, turning the signal circuit into a rain detector. When coupled with a lamp and photocell, it can indicate a customer entering the shop, and so on. The instrument will sound off whenever a suitable input is fed to it.

Fig. 1 shows a block diagram of the unit. The electrical signal from a transducer or battery is amplified, after which it triggers a p-n-p power transistor into audio oscillation. The af energizes a small speaker and produces a tone which is audible over a range of 10 feet or more.

The transistor oscillator is many times more efficient than a mechanical buzzer. Besides, its tone is more pleasant. Very little equipment is needed, and the power supply may be any low-voltage battery. I used 4 volts in this particular unit, but higher voltage may be used if a louder alarm is needed. Standby current (during absence of the alarm) is but a fraction of a milliampere.

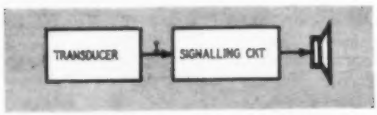
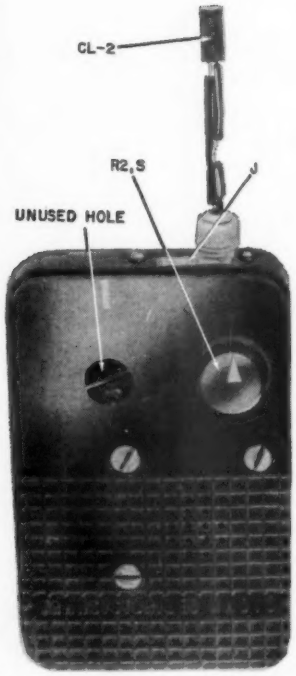
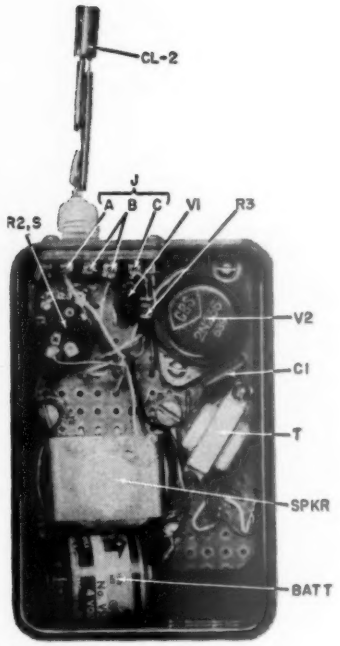


Fig. 1—Block diagram of signaling circuit.



The finished unit fits into a pocket-sized case.



Parts layout inside the case.

The circuit

It is easier to analyze the circuit of Fig. 2 if we assume V1 is temporarily shorted between emitter and collector. Then V2 may be recognized as a conventional Hartley type audio oscillator. Note that the transformer's center tap returns to V2's emitter through the battery. Its base is biased through a volt-dropping string, R1, R3, R4. This circuit will oscillate at about 3,500 cycles when the battery is switched on. Frequency may be lowered by adding capacitance across the transformer primary, but this may reduce the instrument's sensitivity.

When V1 is added as shown, it affects the oscillator's base bias. Normally the transistor's internal resistance is high. This leaves only a small voltage across R1 to bias V2. Under this condition there is no audio tone. However, when

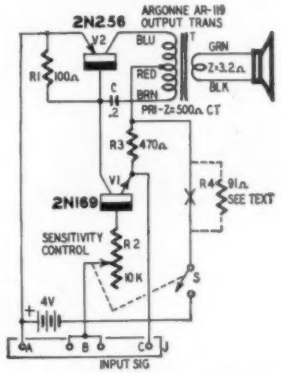


Fig. 2—Circuit of the all-electronic alarm.

R1—100 ohms
R2—pot, 10,000 ohms with spst switch (Lafayette VC-28 or equivalent)
R3—470 ohms
R4—91 ohms, 5%
All resistors ½-watt 10% unless noted
C—0.2 μf ceramic
J—4-terminal jack (Lafayette MS-285 or equivalent)
S—spst on R2
T—output transformer: primary, 500 ohms, ct; secondary, 3.2 ohms (Argonne AR-119 or equivalent)
V1—2N169
V2—2N256
BATT—4 volts, RCA VS-308
Connectors for battery
Case, plastic, 4⅛ x 2⅝ x 1⅛ inches (Lafayette MS-302 or equivalent)
Bakelite board, cut to size (Lafayette MS-304 or equivalent)
Socket, 3-pin, for 2N169
Socket, 9-pin miniature, for 2N256
Knob
Miscellaneous hardware

forward bias is fed into V1, its internal resistance is lowered and a greater voltage appears across R1. If the bias is sufficient, V2 will oscillate.

Forward bias of only 8 μa starts the oscillator. It may be applied between terminals B and C. B must be connected to the *positive* side of the external signal source since V1 is an n-p-n unit. R2 may be used to control the signal input. In general, however, an external resistor will need to be added in series to cut down the signal to only a few μa.

The audio tone may be stopped by reducing the input to about 2 μa or less, or by switching off the battery circuit.

The most obvious application of this device is as a sensitive electronic relay which will sound an audio tone when

Fig. 3—Two accessories: a—rf detector; b—light sensitive probe.

its signal input exceeds 8 μa or so. The signal source may be a sensor plate to detect moisture, for example. Other signal inputs to key the alarm are listed below:

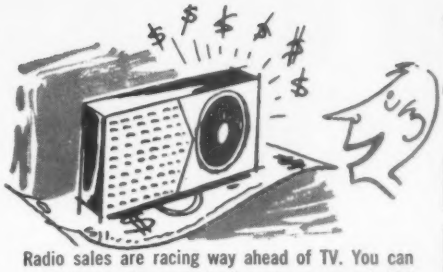
1. A network made up of an rf coil in series with a crystal diode may be connected between terminals B and C. Any rf picked up from a nearby transmitter is detected and fed to V1. The device becomes a CW monitor, giving a loud, pleasant tone every time the key is depressed. A distance of 2 or 3 feet from a 35-watt-transmitter antenna is about right. The coil need not be tuned—a 2.5-mh choke has been found suitable. The diode must be poled with its cathode toward terminal B (see Fig. 3).

2. The internal battery (4 volts) may be used to supply the control signal. When a resistor is connected between terminals A and B, current flows through it from the positive battery terminal. Thus V1's base goes positive. The emitter is already tied to the negative terminal through a pair of resistors. If the added resistor (between A and B) is small enough (270,000 ohms or less), oscillation will start.

This added resistance may be a cadmium sulphide or similar photocell, which has a high resistance when no light falls on it. The resistance then drops as light intensity increases. For example, a Clairex CL-2 cell will set off the audio alarm when placed about a foot from a 30-watt fluorescent lamp. Light from a cloudy sky will also work. A thermistor will do the same job for temperature changes.

3. The alarm may be set off by a combination of signals. If approximately 6 or 7 μa is fed in between terminals

(*Continued on page* 110)



YOU BET THERE'S MONEY IN SERVICING RADIOS!

Radio sales are racing way ahead of TV. You can cash in on this revival—if you're prepared. But todays' transistor sets, FM sets, printed circuit models, hybrid automobile receivers etc. can be tough to handle—unless you know how—and this new Gernsback Library Book shows you. Four alphabetized sections (including a complete section of Charts) help you put your finger on the toughest trouble in minutes. Speed up your servicing—jack up your income. Get your copy of RAPID RADIO REPAIR today.

RAPID RADIO REPAIR
By G. Warren Heath
Gernsback Library Book No. 78
Paper cover ed. $2.90
Hard cover ed. $4.60

OTHER G/L SERVICING BOOKS

Servicing Transistor Radios—No. 76	$2.90
Oscilloscope Techniques—No. 72	2.90
TV and Radio Tube Troubles—No. 68	2.90
Servicing Color TV—No. 65	2.90
Rapid TV Repair—No. 60	2.90
The V.T.V.M.—No. 57	2.50
Sweep and Marker Generators for Television and Radio—No. 55	2.50
Servicing Record Changers—No. 59	2.90
Probes—No. 54	2.50
The Oscilloscope—No. 52	2.25
TV Repair Techniques—No. 50	1.50
Radio & TV Test Instruments—No. 49	1.50
Television Technotes—No. 46	1.50

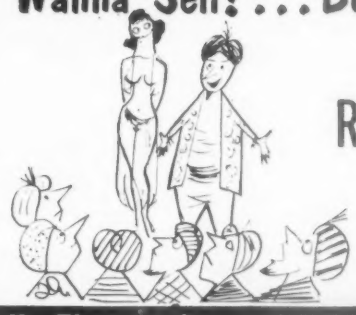
SEE YOUR DISTRIBUTOR OR USE THIS COUPON

Gernsback Library, Inc.—109
154 West 14th St., New York 11, N. Y.

Here's my remittance of $_____
Send me the books checked, postpaid.
78 Rapid Radio Repairs
☐ Paper cover ed. $2.90 ☐ Hard cover ed. $4.60
☐ 76 ☐ 72 ☐ 68 ☐ 65 ☐ 60 ☐ 57
☐ 55 ☐ 59 ☐ 54 ☐ 52 ☐ 50 ☐ 49 ☐ 46

Name_____
(Please Print)
Street_____
City_____ Zone_____ State_____

Wanna' Sell? . . . Buy? . . . Trade?



For best results use
Radio-Electronics
Opportunity Adlets
Rates as low as $5.
50¢ a word—10 word minimum

Radio-Electronics 154 West 14th Street • New York 11, N. Y.

SUPER POWERED SINGLE CHANNEL AMPLIFIER

Minimum 20V—5 Watts on All Channels

This all new super powered unit has the highest output of any TV channel amplifier with sufficient power to cover large communities with ample signal voltage and deliver a strong signal thru many miles of cable. The unit was designed specifically for community television and is the only unit of its kind that does not produce power in fractions of a watt. For full rated output a high-powered commercial transmitting tube is used.

- C. C. S. Service
- 26 db min. gain
- 6-8 mcs. band width
- Channels 2-13 as specified
- Requires only 1 V input
- Co-axial input and output connectors for 75 OHM Line
- Linear class A operation
- Low Power Drain (1 Amp.)

MODEL SPA
$350

Write for details today.

SEG Electronics • 1778-A Flatbush Ave., Brooklyn 10, New York

SHIPPED ON APPROVAL

NEW

CRT TESTER-REACTIVATOR Model CRT-2

Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*

Model CRT-2 **$57.50** Net

TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.

1. **THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** — A tremendous advance over the maize of cable and adapters generally found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 110 degree types from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A special color switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.
2. **WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place, allowing you for the first time to properly control the reactivation voltage. This eliminates the danger of stripping the cathode of the oxide coating. It enables you to see the speed of reactivation and whether the build-up is lasting. You will see if the cathode contamination is too great and if the picture tube is too far gone to be reactivated.
3. **CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers . . . high enough to really do the job — yet controlled to avoid damage to the picture tube.
4. **UNIQUE HIGH VOLTAGE PULSE CIRCUIT** — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
5. **VISUAL LIFE TEST** — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement when necessary.
6. **TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES** — Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these types with the same thoroughness as the regular types with complete safety.
7. **SEPARATE FILAMENT VOLTAGES** — Including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
8. **TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES** — found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary picture tube testers. The CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST

- for quality of every black and white and color picture tube
- for all inter-element shorts and leakage up to one megohm
- for life expectancy

REPAIR

- Will clear inter-element shorts and leakage
- Will weld opens between any two elements in the tube gun

REACTIVATE

- The unique controlled 'SHOT' (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The 'BOOST' method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

ADDITIONAL FEATURES

• Employs the time proven dynamic cathode emission test principle • Large 4½" meter with heavily damped movement for smooth action, accuracy and long life • Provides separate shorts test for each element in the picture tube • Filament continuity is shown on a separate glow indicator • An easy to read instruction manual contains all the latest testing information on old and new type picture tubes • Housed in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord.

*patent pending

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.

in-circuit checks:

- Quality of over 80% of all condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of 100% of all condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammertone finish steel case . . . comes complete with test leads

Model CT-1 **$34.50** Net

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

EASY TO BUY IF SATISFIED — *see order form on facing page* ➡

FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

❶ DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

Housed in hammertone steel-case — complete with MULTI-PROBE

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

OUTSTANDING FEATURES

● Completely portable — self powered with long life batteries — permits use everywhere ● New advanced pentode amplifier circuit assures amazingly low battery drain ● Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s ● Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC ● Simplified multi-color easy-to-read 4-scale meter ● No heat operation assures rigid stability and accuracy ● Immune to power line fluctuations ● Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments ● Meter completely isolated — practically burn-out proof ● Hand-crafted circuitry eliminates the service headaches of printed circuitry ● 1% resistors used for permanent accuracy ● Separate RF ground return for low-loss RF measurement ● Microphone type co-axial connector ● Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- **DC Volts** — 0 to 1.5/6/30/150/300/600/1500 volts
- **AC Volts (RMS and Peak-to-Peak)** — 0 to 3/12/60/300/1200 volts
- **Ohms** — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- **RF** — Peak reading demodulator supplied for use on all DC ranges
- **Zero Center** — available on all DC volt ranges with zero at mid-scale
- **Decibels** — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- **Impedance** — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- **Input Capacity** — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 **$58.50** Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

Housed in hand-rubbed oak carrying case complete with CRT adapter

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

● No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers ● No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement ● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● 41 phosphor bronze beryllium tube sockets never need replacement ● 7-pin and 9-pin straighteners mounted on panel ● Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● Compensation for line voltage variation ● 12 filament positions ● Separate gas and short jewel indicators ● Line isolated — no shock hazards ● Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

Model FC-2 **$69.50** Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying direct from the manufacturer.

CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue, Dept. 110, Mineola, New York

CHECK INSTRUMENTS DESIRED

- ☐ Model CRT-2 CRT TESTER REACTIVATOR ..... $57.50 $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50 $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50 $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50 $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name ..... Please print clearly

Address .....

City ..... State .....

A QUARTER-CENTURY OF *PRECISION* KNOW-HOW IS YOURS IN

PACO

QUALITY ELECTRONIC EQUIPMENT IN KIT FORM

FOR:
electronic hobbyists and amateur radio

hi-fi custom building and service

science education and technical schools

industrial testing and quality control

PACO is the only line of test instrument kits engineered and produced under the auspices of a leading test equipment and meter manufacturer.

and, you pay nothing extra for the convenience of buying PACO kits directly from your own local parts distributor.

COMPARE PACO against any other kits for performance, appearance, ruggedness, ease of operation and simplicity of assembly and wiring.

COMPARE PACO's superbly detailed, step-by-step instruction manuals and giant size wiring diagrams, against any you have ever seen.

SEE HOW PACO sets an entirely new standard in electronic instrument kit design and kit assembly instruction.

■ *Available and on display at leading electronic parts distributors.*

■ *Write for latest, complete catalog.*

PACO
Electronics Co, Inc.,
70-31 84th St., Glendale 27, L. I., N. Y.
Export: 458 B'way, N .Y. 13, U.S.A.,
Canada: Atlas Radio Corp., Toronto 19.
A DIVISION OF
PRECISION APPARATUS CO., INC.

MODEL B-10
Battery Eliminator Kit
• less than 0.3% ripple output
• no external filters required
Kit Net Price: $41.95
Factory Wired: $49.50

MODEL S-55
Wideband 5" Oscilloscope
• response DC to 5 Mc
• push-pull V and H amplifiers
Kit Net Price: $87.50
Factory Wired: $139.50

MODEL C-20
Res-Cap-Ratio Bridge Kit
• 10 mmfd to 2000 mfd
• ½ ohm to 200 megs
Kit Net Price: $20.95
Factory Wired: $31.50

MODEL T-60
Tube Checker Kit
• full free-point lever selector system
• built-in roll chart
Kit Net Price: $38.75
Factory Wired: $54.50

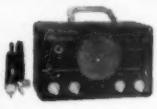
MODEL G-30
RF Signal Generator Kit
• 160 Kc to 240 Mc in 8 bands
• 120 Mc fundamental output
Kit Net Price: $28.50
Factory Wired: $39.95

MODEL T-65
Transistor and Crystal Diode Tester Kit
• tests Icbo, gain, leakage, etc.
• tests both p-n-p and n-p-n types
Kit Net Price: $39.95
Factory Wired: $59.50

MODEL M-40
High Sensitivity V-O-M Kit
• 20,000 ohms/volt DC
• 10,000 ohms/volt AC
Kit Net Price: $31.50
Factory Wired: $37.50

MODEL V-70
Vacuum Tube Voltmeter Kit
• wide-range
• peak-to-peak
Kit Net Price: $31.50
Factory Wired: $47.50

MODEL S-50
5" Cathode Ray Oscilloscope Kit
• push-pull vertical and horizontal amplifiers
Kit Net Price: $49.50
Factory Wired: $84.50



MODEL Z-80
RF-AF Signal Tracer Kit
• high gain RF and AF amplifier
• visual and audible indicator
Kit Net Price: $29.50
Factory Wired: $42.50

MODEL SA-40
40-Watt Stereo Preamp-Amplifier
• silicon diode, low impedance power supply
• 14 controls for optimum flexibility
Kit Net Price: ..... $ 79.95
Factory Wired: $129.95

COMING SOON!
MODEL ST-45
AM/FM Stereo Tuner Kit
Matching companion for the SA-40

PACO

ELECTRONICS

(*Continued from page* 107)

B and C, the instrument becomes very sensitive and only 1 or 2 more μa will set off the electronic relay. Under this condition even a slight acoustic shock is sufficient. For example, tapping the speaker or blowing onto its cone will start oscillations.

This instrument has been described as a trigger device that has only two states, on or off. It is also useful as an amplifier as shown below. This is a table of input signal (across B and C) vs. total battery current.

Signal (μa)	Battery (ma)
0	0.3
2.2	0.4
7.0	0.8
8.2	1.0 which triggers to 5.0
25.0	10.0

Note that small changes of input may be measured until about 1 ma when the oscillator is abruptly triggered to 5 ma. Battery currents between these values are not observed. After oscillations start, increasing the signal increases battery drain still further (and of course produces louder sounds).

Resistor R4 has an important job. Although it greatly reduces the circuit's sensitivity, it makes it possible to stop the tone by reducing the input signal. Without R4, the tone can be triggered by as little as 2 μa, but it will not cease even when the signal is removed. Only switching off the battery will stop the alarm. (R4 was not used in the model shown in the photo.)

Construction kinks

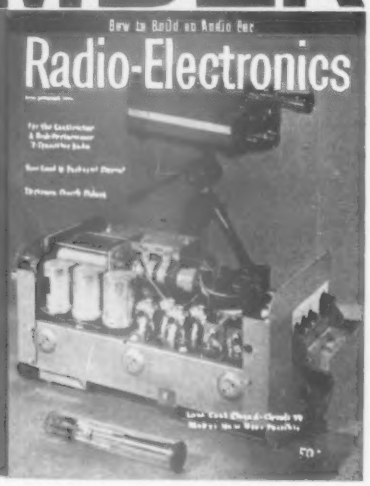
The electronic relay alarm is built into a plastic case (Lafayette MS-302) which has become popular with experimenters. Only one control appears on the front. This is the on–off switch combined with a potentiometer. All parts except the battery are mounted on a perforated bakelite board. See photo for layout.

Jack J (Lafayette MS-285) has four contacts. The inside contacts are tied together. Then a plug (MS-283) can be inserted into the desired pair. The inner contacts (which are connected together) are shown at B in Fig. 2. Therefore the plug can contact either A–B or C–B, as desired. The photo shows a photocell (CL-2) hooked up for a light-operated alarm circuit or for measuring light intensity. END

NEW in NOVEMBER

INDUSTRIAL ELECTRONICS — a new section devoted entirely to electronic applications in industry. Practical articles on new equipment, developments, techniques, servicing problems and opportunities in this vast new field which is rapidly opening up so many new opportunities for the technician.

Here's a preview of the November edition of the new Industrial Electronics Section.



ELECTRONICS ON THE TELEPHONE — Electronics is making rapid inroads into a field that was strictly electrical until recently. An absorbing story of how this has come about together with circuits of the newest line amplifiers and other equipment.

SERVICING ELECTRONIC WHEEL BALANCERS — Even your local garage is feeling the touch of electronics—a look at the equipment your neighborhood automobile mechanic is using—and how to maintain and repair it.

PRINTED CIRCUITS IN NEW FORMS — Challenging problems and special techniques of printed circuitry in computers, industrial control systems, high-temperature equipment, etc.

ELECTRONICS WORKS ON THE RAILROAD —The wedding of America's oldest and newest industry! How electronics makes reservations, sells tickets, supervises yard operations, improves communications, cuts costs.

BUT THE BALANCE REMAINS

The new section will not disturb RADIO-ELECTRONICS finely balanced and neatly diversified lineup of articles on Electronics, High Fidelity, Television, Radio, Test Instruments—and the usual departments. See . . .

NEW CLOSED CIRCUIT TV — Cover feature on a development that opens new vistas in closed circuit TV applications—including use in the home.

CHURCH-CHIME PROJECTION SYSTEMS How to make extra money servicing them.

SEVEN-TRANSISTOR RECEIVER — A pocket-size portable for the constructor.

STEREO IN A PACKAGE — Fancy furniture or fine equipment? This article weighs the evidence.

To maintain and improve the standards that have made RADIO-ELECTRONICS the most interesting and liveliest-reading magazine in the field, we must raise the single-copy price to 50c effective with the NOVEMBER 1959 issue. We don't like to do this, but we are sure readers will understand why we must from their own battles with the budget. Our subscription rates will remain the same only sometime next year to give regular readers the chance to subscribe now at the present low rates.

SUBSCRIPTION RATES

3 years $10 2 years $7 1 year $4

You can save up to $8 over the newsstand price by subscribing now.

Radio-Electronics 154 West 14th Street New York 11, N.Y.

ELECTRONICS

Technicians look at ELECTRONIC WEIGHING SYSTEMS

Part II—How to service the electronic scale

By EDWIN BOHR

LAST month we saw the how and why of electronic weighing—how it works, what electronic circuits are used, etc. This month we will see how various operating faults can be diagnosed for rapid servicing.

Operation and service

Any competent electronic technician can spot a burned-out tube in the amplifier of an electronic weighing circuit. However, for any other maintenance or adjustment, insist upon a complete system wiring diagram and instruction manual. Read and study it carefully.

Almost every weighing system is custom designed in at least one respect and a good look at the diagram is worth several hours of fumbling in the dark. Furthermore, if you make changes without knowing what you are doing, the system will probably wind up in worse shape than if it had been left alone.

The amplifier is generally a straightforward audio type. The majority have a dual-triode output stage that, instead of driving a speaker, supplies power to a motor winding. (This is called the control winding). Most are Minneapolis-Honeywell-Brown units without a chopper.

The Cox & Stevens weighing system, however, is quite different. It supplies the load cells with approximately 400-cycle power from an electronic oscillator power amplifier. The null amplifier amplifies the 400-cycle error signal to a level of a few volts. At this point, the 400-cycle error signal is converted to a plus or minus dc signal by a phase-sensitive detector. Next, the dc is mixed with the output from a small dc rate generator connected to the weight-indicating pointer.

The generator measures how fast the pointer is moving and tends to keep it from overshooting, if the weight change should stop abruptly.

The dc signal is then changed to a 60-cycle signal by a phase-sensitive modulator and the 60-cycle signal is amplified by a couple of beam power tubes that drive the control winding of a 60-cycle motor.

In some ways, the unit can be compared to a double-conversion receiver, since amplification occurs at two carrier frequencies.

Also interesting is the fact that all these null-balance units are suppressed-carrier double-sideband systems. With the system at rest, the excitation frequency is cancelled (suppressed) and does not appear at the amplifier input. Only when there is some change (modulation) does a signal appear and it is the excitation (carrier) frequency, plus or minus the frequency of the error signal.

The dual-conversion feature of the Cox & Stevens unit allows the 400-cycle amplifiers to discriminate against 60-cycle noise and harmonics. It also allows the use of a somewhat less expensive dc type rate generator. The generator is absolutely necessary, considering the lightning speed with which the Cox & Stevens unit can move.

Sluggishness and hunting

Aside from the usual tube replacements, the most frequent complaints are sluggishness and hunting (oscillating back and forth). More often than not, the solution is to readjust the amplifier's gain control carefully.

The system is sluggish if the indicator wheel or pointer can be pushed either way more than one significant figure without its immediately returning to its normal position when the push is removed. Either too much or too little gain can produce this condition. Too little gain means there is not enough amplification to turn the motor and too much gain causes the error signal to be lost in a background of excessive noise and stray pickup.

The gain control is usually recessed in the amplifier chassis. However, if at all possible, mark the original gain-control position for reference. Now, turn it all the way down and then *slowly* increase it. As the control advances, the pointer at first will be limp in response to a finger push. Then, it will begin to push back with more and more stiffness. Next, the pointer will begin to oscillate wildly, finally becoming sluggish again.

The optimum gain point is *just below* the zone in which the pointer *oscillates*. Proper adjustment is rather critical and backlash in the screwdriver slot may make adjustment even more difficult. Use a screwdriver with a blade that completely fills the slot. If necessary, blunt the screwdriver tip on a piece of masonry or heavy metal.

Wild oscillation, or hunting with too much gain, is caused by souped-up acceleration which makes the indicator overshoot the balance point by a wide margin. As the pointer backs up to the point of balance, it continues to overshoot.

If the system is still sluggish, despite careful adjustment of the gain control, the trouble is probably caused by capacitance unbalance. Although we usually

Digital number-wheel type electronic weight indicator. *Streeter-Amet Co.*

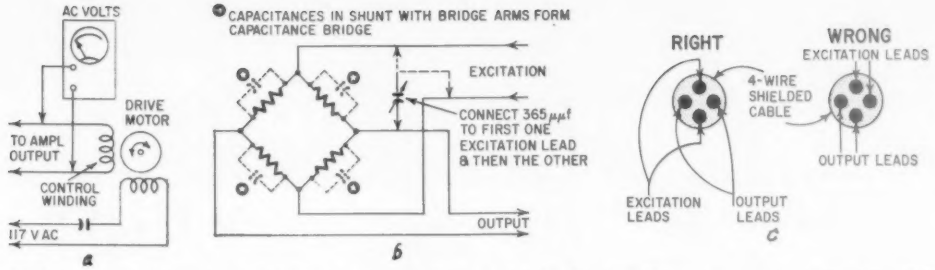


Fig. II-1—Service hints: a—connect ac voltmeter across the motor's amplifier (or control) winding to measure quadrature voltage; b—method of using variable capacitor to balance stray capacitances; c—stray capacitances in load-cell cable balance best if cable is wired right.

think only of the output voltage from the load-cell resistors, there are also capacitances everywhere in the circuit and they are especially high in the cables feeding the load cell.

If these capacitances are not adequately self-cancelling, they introduce out-of-phase signals (called quadrature currents) that overload the amplifier and mask the signals from the load cells. Besides masking the resistive signal, they cause the true instrument zero to shift somewhat.

First, diagnose the excess quadrature by connecting an ac voltmeter across the motor's control winding, as in Fig. II—1-a. (For the Cox Stevens unit, measure the output of the 400-cycle amplifier with an oscilloscope and follow the instruction manual.) If the meter reads more than about 35 volts with the motor at rest, you can be almost certain the quadrature is excessive. (The motor does not turn with even this much voltage across the control winding because of the phase difference.)

Reduce the capacitance unbalance by connecting a 365-$\mu\mu$f tuning capacitor (Fig. II—1-b from one output lead to first one excitation lead and then the other. Watch the motor volts as the capacitor is rotated. (Do not touch the capacitor directly. Use a large nonmetallic knob.) The connection and capacitance that give lowest motor volts should be noted and a fixed capacitance substituted and wired in permanently across a suitable terminal strip in the instrument. The capacitor should be mica or, even better, silver mica. When it is installed, check the motor volts again to be sure the reading is still as low as possible.

For multiple load cells, series-connected, it may be necessary to juggle capacitor values on all load cells for a really low motor-volts reading.

It is sometimes possible to balance the capacitance so close that the motor-volt reading is almost zero. This is excellent for the moment, but the balance will vary as cable and instrument capacitances change with temperature and time. Therefore, you may be called to rebalance the capacitances perhaps a year or so later.

Fig. II—1-b shows how the stray capacitances form a capacitor bridge around the load cell. The capacitances can be kept more closely balanced if the cables to the load cell are connected as in Fig. II—1-c.

Dirty slide-wire

Another common trouble is a dirty slide-wire. It usually shows up as erratic or jumpy action at particular positions of the indicator dial or wheels. If the slide-wire is exposed, clean it with a *Pinkpearl* type eraser available from drawing-supply stores. *Use nothing else.* Abrasion may damage or ruin the calibration.

A thin film of petroleum jelly may be used as a slide-wire lubricant.

Often, the slide-wire is a 10-turn type sealed potentiometer. It may sound like a quack idea, but often these expensive potentiometers may be completely cured of noisy spots by applying Quietrole around the shaft bushing slowly, but liberally, with the shaft in a vertical position. Then, rotate the pot and tip it in several directions to distribute the few drops of cleaner–lubricant inside.

If you have to remove any wires, always tag their original positions clearly. The precision resistors in the measuring circuit must be protected from excessive soldering temperatures by holding their terminals with long-nose pliers. Any replacement of the slide-wire, a precision range resistor, the distribution transformer or a load cell make it necessary to recalibrate the instrument range with dead weights. This is expensive and time-consuming. *So stay away from changing these components.*

However, be on the lookout for moisture or water in cable connectors and junction boxes. Leakage of 100,000 ohms from an excitation lead to an output lead can push the system completely off range. Furthermore, look for intermittent or corroded connections and even a broken or cut cable.

If you enjoy working on new types of electronic equipment, you will certainly get a kick out of electronic weighing systems. (Some technicians, in fact, feel they have been kicked once too often by electronic weighing.) It is undoubtedly one of the most interesting pieces of new electronic equipment to appear in industry.

A few companies active in this field are listed below.

Baldwin, Lima, Hamilton
Electronics & Instrumentation Div.
Waltham, Mass.

Cox & Stevens Weighing Equipment
Revere Corp. of America
Wallingford, Conn.

Gilmore Industries
5713 Euclid Avenue
Cleveland 3, Ohio

Streeter-Amet Co.
Grayslake, Ill.

Tatnall Measuring Systems Co.
P.O. Box 245
Phoenixville, Pa.

END

Precision load cells. Compression type unit on left (about 3 inches high) has rated capacity of 50,000 pounds. Tension type load cell on right.

Cox & Stevens Weighing Equipment Photos

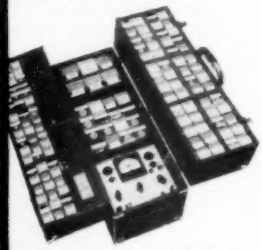
Portable aircraft weighing kit has guaranteed accuracy of 0.1% of applied load.

XCELITE® PLIERS
have a ...

No. 62CG illustrated
Transverse Cutter
New CUSHION GRIP!
Plier handles have dipped plastic coating . . . permanent, comfortable.
Heads polished and buffed to a "mirror finish".
All pliers available . . . See Your Distributor!
Gives pliers a "Feel" that inspires Craftsmanship!
XCELITE, INCORPORATED
ORCHARD PARK, NEW YORK
Canada: Charles W. Pointon, Ltd., Toronto
XCELITE Quality Hand Tools
PREFERRED BY THE EXPERTS

HOW & WHY of
HI-FI & STEREO
NEWEST AND BEST
HI-FI STEREO BOOK

Has all the answers. Explains how Hi-Fi Stereo components work. Tells HOW and WHY to select amplifiers, preamps, record players, tuners, tape recorders, microphones, pickups, speakers and enclosures.
Tells how to read mfr's specs of Hi-Fi equipment. Shows how to adapt monoaural systems to stereo. Contains easy way to use decibels. Also explains distortion and means of eliminating it. Explains feedback, Williamson & Ultra-Linear circuits, impedance matching, audio power needs, crossover networks, equalization, volume compression and expansion, bass and treble boost, pickups and cartridges, styli and many other subjects.
Includes latest stereo developments in record players, tuners and tape recorders.
STROBOSCOPE DISC in each book!
BIGGEST HI-FI STEREO DOLLARS WORTH
$1 Postpaid
Guaranteed Money Back in 5 Days if not Satisfied
SPECIAL INTRODUCTORY OFFER!
ABSOLUTELY FREE with each order: Your choice of Cisin's newest books: BASIC ELECTRICITY—Vol. 1 or TV & RADIO TUBE SUBSTITUTION GUIDE. These sell for 50¢ ea. ACT NOW—get 2 books postpaid at cost of only one!
RUSH COUPON NOW!
H. G. CISIN, Consulting Engineer—Dept. E-52
Amagansett, N.Y.
Enclosed find $1. Rush HI-FI & STEREO & free book marked above. (If not marked Basic Elec. will be sent).
☐ Send all 3. Enclosed find $1.50.
Name
Address
City Zone State

VIS-U-ALL
BUSINESS BUILDING TEST EQUIPMENT FOR SERVICE DEALERS
here's
MONEY MAKING CONVENIENCE

tubes, tools and built-in tube tester . . . all in one handy case!
THE V100 DYNAMIC CADDY-TESTER
Built-in tester checks over 800 TV-radio tubes dynamically; also tests picture tubes and selenium rectifiers. On house calls, you test all tubes in a set . . . sell more, make more! Only 4 sockets and exclusive Master Switch test all receiving tubes, past, present and future. Never obsolete. Well built, professional caddy holds 150 tubes.
ONLY $109.00
Write for Details
VIS-U-ALL PRODUCTS CO.
645 EASTERN, S. E.
GRAND RAPIDS 6, MICHIGAN

ELECTRONICS

SIMPLE TRANSISTOR TIMER

Simple unit for home or shop uses only one transistor

By JOSEPH BRAUNBECK

BUILDING an electronic timer is a satisfying project for every electronic hobbyist. A good timer can be used for cooking eggs, enlarging photographs or hundreds of other purposes. It should not be a bulky piece of equipment with a big appetite for power, but a neat little self-contained unit. A junction transistor makes this possible.

To understand the transistor circuit it helps to discuss an equivalent vacuum-tube circuit first.

Fig. 1 shows a capacitor connected between grid and cathode of a triode, parallel to the grid resistor. If switch S is momentarily closed, the capacitor will be charged and V's grid becomes negative.

If the BATT 1's voltage is high enough the tube will be blocked for

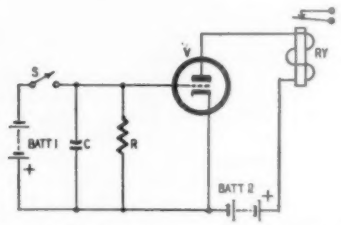


Fig. 1—Basic vacuum-tube timer circuit.

some time—until the capacitor has discharged through resistor R. The length of time the tube remains blocked depends on the values of R and C. The greater R and the greater C, the longer the time.

If a relay is connected in the tube's plate circuit, it switches any device on or off for the time determined by R and C.

Transistor circuit

The tube circuit is easy to transistorize. A p-n-p junction-transistor behaves very much like a vacuum tube with reversed polarities. Think of the emitter as cathode, the base as grid and the collector as plate. Consequently

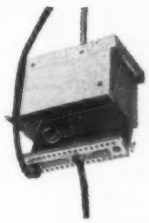
IS ONE OF THESE TYPICAL BLONDER-TONGUE AMPLIFIED INSTALLATIONS THE ANSWER TO BETTER TV RECEPTION IN YOUR AREA?

Blonder-Tongue reception improving TV products

NEW BLONDER-TONGUE B-24 POW-R BOOSTER

Powerful booster or amplified coupler provides sharp, clear pictures on 1, 2 or more TV sets with only one antenna. 10 db gain as 1-set booster, 5 db gain per set as amplified 2-set coupler. No-loss 4-set distribution system with B-T A-104 4-set coupler. New 6DJ8 frame-grid tube for highest signal gain. 24.95 list

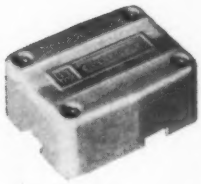
NEW VHF ANTENNA BOOSTER, MODEL AB-2



Brilliant, clear reception in fringe and weak signal areas — more than 10 db gain on all VHF channels. Utilizes advanced RF amplifier circuit with frame-grid tube for maximum signal-to-noise ratio. Can be mounted up to 500 feet from remote control unit. 53.95 list

Model AB-FM for superior FM reception. 53.95 list

'NO-STRIP' 2-SET COUPLER, MODEL A-102



300 ohm coupler provides low-loss, matched installation for superior two-set performance. Delivers more signal to each TV or FM set, with greater inter-set isolation than other couplers. No ghosts, no smears. Ideal for outside or indoor mounting, color TV, FM. 3.50 list

Model A-104 — 4 set coupler, list 4.50; Model A-105 high-low antenna list 3.50; A-107 UHF-VHF Mixer, list 3.50; A-100 Outdoor Mounting Kit, list 90¢

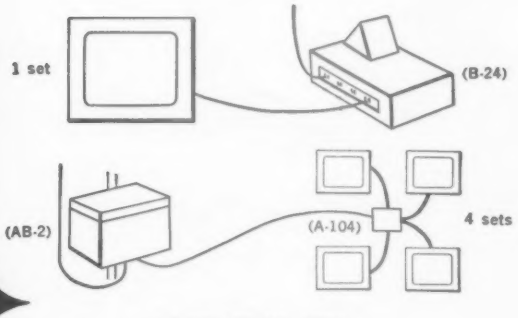
DISTRIBUTION AMPLIFIER, MODEL DA8-B

Powerful all-channel amplifier ideal for small TV systems (garden apartments, motels, TV showrooms), provides 8 isolated TV outlets from 75 or 300 ohm input and delivers more than 10 db gain on all VHF channels. Requires no tuning or other special accessories. 94.50 list

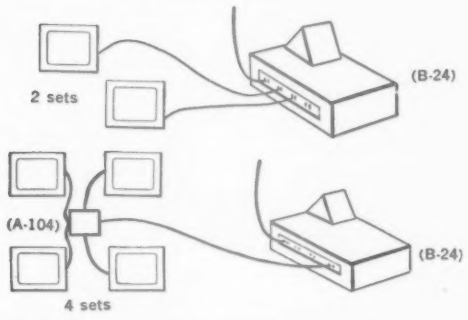
for every reception area — primary or fringe. for every type of installation — one set to 100

WEAK SIGNAL AREAS

INTERMEDIATE SIGNAL AREA

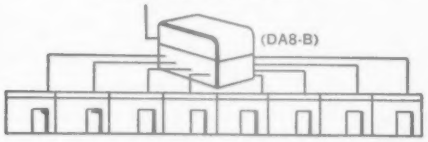


PRIME SIGNAL AREA



WEAK, INTERMEDIATE, PRIME SIGNAL AREAS

Small TV System — 8 sets



'NO-STRIP'— these Blonder-Tongue TV products feature exclusive B-T No-Strip terminals for speedy, secure positive installation.

More than 2,000,000 installations provide superior TV reception with B-T products.

Available at parts distributors. For further information write Dept. RE-10

BLONDER-TONGUE LABORATORIES, INC.

9 Alling St., Newark 2, N. J.

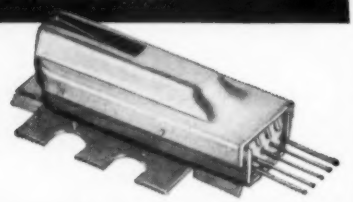
In Canada: Telequipment Mfg. Co., Ltd., London, Ont. Export: Morhan Export Corp., N. Y. 13, N. Y.

hi-fi components • UHF converters • master TV systems • industrial TV cameras • FM-AM radios

PICK THE BEST FOR YOUR STEREO PICKUP SYSTEM by

WEATHERS

These are the same components which play an important role in producing Weathers TrioPhonic Stereo—the sound that outmodes conventional stereo.



StereoRamic Cartridge C-501

The first ceramic cartridge to outperform the finest magnetic pickups.

SPECIFICATIONS

Frequency Response	15-30,000 cps
Compliance	6 x 10^{-6} cm/dyne
Dynamic Moving Mass	1.0 milligrams
Recommended Tracking Force	
Professional Arms	1-2 grams
Changers and other type arms	2-6 grams
Stylus	0.7 mil diamond or sapphire
Separation	25 db
Signal-to-noise Ratio	—60 db
Output per channel	0.25 Volts 7 cm/sec

Audiophile Net

C-501-D—Diamond....$17.50
C-501-S—Sapphire....$9.75

StereoRamic Pickup System

MC-1. Features the StereoRamic cartridge and the Micro-Touch Tonearm. Leads plug directly into the phono magnetic input of all preamplifiers.

SPECIFICATIONS

Arm Bearing System	Viscous Damping
Tracking Force	Easily adjusted 1 to 8 grams
Finish	Ebony with gold trim
Overall Length	13 inches
Pivot to Stylus Tip Length	9¾ inches
Recommended Overhang	½ inch

Audiophile Net

MC-1-D—(Diamond)....$55.95
MC-1-S—(Sapphire)....$48.25

For more information about Weathers components, write for "The Audiophile's Album"

WEATHERS INDUSTRIES

Division of Advance Industries, Inc.

66 E. Gloucester Pike, Barrington, N.J.

Export: Jos. Plasencia, Inc., 401 Broadway, N. Y.

a positive base voltage will block the transistor, as a negative grid voltage blocks a tube.

Fig. 2 is the transistor version of Fig. 1. If you close switch S, capacitor C is charged and the transistor is cut off. Capacitor C discharges through resistor R. After a certain time, which depends on the values of R and C as well as on the electrical properties of the transistor, collector current starts flowing again and the relay is energized.

A difference between the tube and transistor circuit is that the transistor is not blocked completely. Collector current of a few microamperes remains. Without a blocking voltage, the

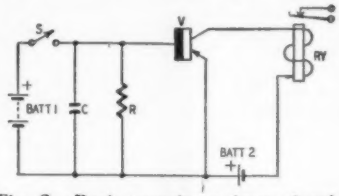


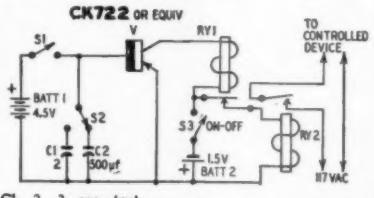
Fig. 2—Basic transistor timer circuit.

collector current is several hundred microamperes.

Another difference between tubes and transistors lies in the fact that there is not as perfect isolation between base and emitter as there is between a tube's grid and cathode. In fact, an appreciable part of the discharge current flows through the transistor's input circuit. It is even possible to omit resistor R and discharge the capacitor through the transistor input. We used this method in our experimental models.

Discharge time is proportional to the capacitor value, as larger capacitors take longer to discharge. Discharge time also varies with transistor type and slightly with different transistors of the same type.

A practical circuit for a transistor timer is shown in Fig. 3. A CK722



C1, 2, 3—see text
RY1—spst, sensitive plate relay, 0.1 ma, normally closed, 5,000 ohms or less
RY2—spst, power relay, normally open, operate from battery or ac line
S1—spst, momentary contact, pushbutton normally open
S2—single-pole rotary, as many contacts as necessary to supply desired delays
S3—spst, toggle
V—CK722
BATT 1, 4.5 volts, 3 penlight cells in series
BATT 2, 1.5 volts, penlight cell.

Fig. 3—Circuit of a practical transistor timer. Delay capacitors discharge through transistor.

p-n-p junction transistor is used. Collector supply voltage is 1.5 (a single flashlight cell). Blocking voltage is 4.5 (three penlight cells). Charging capacitors for different delays may be selected with a single-pole rotary switch. Elec-

HOW TO MAKE MONEY

Selling Commercial Sound

Here today and here tomorrow — Commercial Sound is a steady-profit 12-months-a-year business of sales, installation and servicing with lots of customers right in your own neighborhood.

Take advantage of the Atlas complete line of speakers — manufactured, advertised and supplied directly by Atlas.

Speakers for every application, a mike support for every purpose — plus a wide variety of accessories so necessary for a complete professional installation.

Good markets in stadia, racetracks, athletic fields, etc.
Profitable markets in swimming pools, amusement parks, clubs, schools, etc.
Excellent markets in industry, factories, warehouses, etc.

Write for latest catalog and selling aids to help you get profitable commercial sound business.

ATLAS SOUND

ATLAS SOUND CORP.

In Canada: Atlas Radio Corp., Toronto, Canada

trolytic capacitors are preferred because of their smaller size. Many low-voltage miniature electrolytics are now available.

In the transistor's collector circuit there is a relay which actuates contacts at a current of 0.1 ma. As the delicate contacts of the relay (RY1) would burn if you switched power on and off with them, a second relay (RY2) is triggered by RY1.

As the transistor is blocked during the timing, RY1 must be a normally closed type. If a signal is desired after a certain time, RY2 may be replaced by a buzzer or pilot light.

Calibration

With the help of a stop watch or a similar timekeeper, calibration is easy. For each delay the capacitor's value may be determined by trial and error, either selecting the capacitor from a large stock or by combining smaller values.

Once calibrated, the timer will stay fairly constant, though there is a small temperature sensitivity. END

PREDICTS END OF SERVICE

NATESA Scope reports, in an item signed by Frank Moch, "The other day in Chicago Robert Galvin, president of Motorola, made a number of statements which I believe should be taken to heart by all independent home electronics service people. What he said was not really news; NATESA has been saying it for years. The important thing here is that it came right from the horse's mouth as a statement made by a man who is in a position to know and as one who will play a definite role in making these predictions come to pass. Mr. Galvin said in part:

"'There's a direct relationship between the number of tubes in a radio or TV set and the frequency with which the repairman comes to your house.

"'In about 5 years, there's no reason why radio and TV receivers shouldn't be virtually service-free. As an intermediate step, there's a good chance TV's may be self-serviced. You merely unplug a unit and replace it with another.

"'Our goal is to leapfrog this and go right to service-free units.'

"I hope that the full implications of the above hit a responsive chord in your mind. Here is a man who knows whereof he speaks, who has seen the development of the changes that will at long last free you of the nasty problems of fixing those 'lousy' sets. Such engineering achievements as perfected snap-in printed boards, stabilized superminiature components, modules, transistors and other solid-state devices, plus other developments already on the drawing boards waiting for the right moment to break through, will change your life.

"They will free you of today's urgent need to fight like hell against such things as captive service, unfair distribution practices, drugstore tube peddlers, phony trade schools, adverse publicity and other ills of the industry. One consolation, if service people who too often are lethargic about their own welfare want one, is that when trouble-free home electronic devices do become a reality, captive service, unfair distributors, drugstore tube peddlers, phony trade schools, unfair competition and other things which now hurt you will also be out of business. Won't that be wonderful?"

AVR

the NEW PERMA-POWER

Model D-200

Automatic Voltage Regulator

will make you money and save you grief

It's easy to sell. There have been units similar to this on the market before—at prices upwards of $75.00. The new PERMA-POWER Automatic Voltage Regulator has a list price of $9.95—so *any* TV set owner can afford it . . . and any customer plagued by picture flutter, shrinking, flop-over, loss of brightness, and other similar disturbances will *want* it.

It's easy to use. This new unit insures top performance of TV sets by *automatically* returning full height and width to pictures when distorted by low line voltage. Whenever the line falls below 110 volts, it *automatically* boosts line voltage 10 volts—and it *automatically* feeds the line direct for normal voltages. *You don't have to worry about the customer's forgetting to switch the voltage regulator when the line is normal;* this new PERMA-POWER unit switches automatically!

It's easy to install. You plug it in, and it's ready to work; goes on and off with TV set. Compact and lightweight, it has no tubes, ballasts, relays, or other moving parts to fail; and it's fully guaranteed for one year. Can be used on any TV set or appliance rated up to 300 watts. See it at your distributor today.

Perma-Power COMPANY 3106 N. ELSTON AVENUE CHICAGO 18, ILLINOIS

Unbelievable LOW PRICES!

NOT KITS . . . But Factory Wired and Guaranteed

HIGH QUALITY INSTRUMENTS

New! Model B-45 Radio & TV

SIGNAL GENERATOR

Provides highly stable signal. Generates R.F. frequencies from 150 Kilocycles to 50 Megamentals and from 11 Mc. to 50 Mc. on cycles. (150 Kc. to 12.5 Mc. on Funda-Harmonics). R.F. is obtainable separately or modulated by the Audio Frequency. Measures 7¾"×7¾"×5". Weight 8 Lbs.

Complete — only $14.95

New! TC-75 Univ. Combination

TEST SPEAKER & SIGNAL TRACER

Plus resistor tester
Plus condenser tester
Plus output indicator
Plus speaker substitution. *Plus* resistor substitutor
Plus substitute 100 V D.C. power supply
Plus field substitutor. *Plus* condenser substitutor
Plus voice coil substitutor
Plus signal tracer
Plus universal output transformer
Plus experimental one stage audio amplifier
Measures 7" x 11" x 5". Weight, 8 Lbs.

Complete — only $19.95

Order directly from METROPOLITAN ELECTRONICS • 106 Fifth Ave., New York 11, N.Y.

RADIO • TV • HI-FI • HAM • BROADCASTING • INDUSTRIAL • LAB

RCA KITS

FOR VALUE, QUALITY AND PERFORMANCE!

RCA WV-38A (K)

VOLT-OHM-MILLIAMETER

only $29.95* *(includes batteries, probe and cable with slip-on alligator clip, ground lead and clip, assembly and operating instructions) (available factory-wired and calibrated—only $43.95*)*

Exclusive features make this RCA VOM kit the buy of a lifetime! Extra 1-volt and 0.25 volt (250 mv) ranges for wider usage in transistor servicing—new handle clip accommodates probes and test leads for extra carrying convenience. Assembles in a breeze!

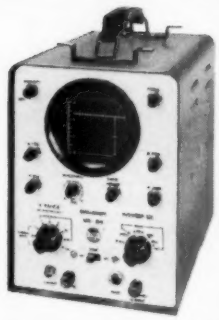
FEATURING: ohms-divider network fuse-protected • easier-to-read scales • extra-large 5¼ inch meter • polarity reversal switch • excellent frequency response • full-wave bridge rectifier • low circuit loading • standard dbm ranges.

SPECIFICATIONS: Input Resistance—20,000 ohms per volt on DC; 5,000 ohms per volt on AC • Accuracy—± 3% DC, ± 5% AC (full scale) • Regular Scales—2.5, 10, 50, 250, 1000, 5000 volts, AC and DC; 50 μa 1, 10, 100, 500 ma, 10 amps (DC) • Extra Scales—250 mv. and 1 volt (dc) • Frequency Response—AC-flat from 10 cycles to 50 Kc (usable response at 500 Kc) • Ohms—3 ranges: Rx1—(0-2,000 ohms); Rx100 (0-200,000 ohms); Rx10,000 (0-20,000,000 ohms) • Dimensions—W. 5¼", H. 6⅞", D. 3⅛"

RCA WO-33A (K)

3-INCH OSCILLOSCOPE

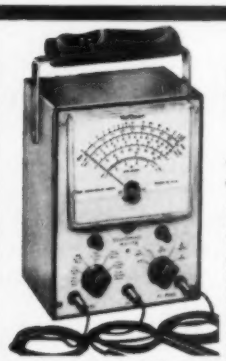
only $79.95* *(complete with Low-Cap, Direct Input Probe and Cable) (also available factory-wired and calibrated—only $129.95*)*



The first 'scope kit with "get-up-and-go!" Use it for practically everything—video servicing, audio and ultrasonic equipment, low level audio servicing of pickups, mikes, pre-amps, radios and amplifiers, troubleshooting ham radio, hi-fi equipment, etc.—and you can take it with you, on the job, anywhere!

FEATURING: voltage-calibrated frequency-compensated, 3 to 1 step attenuator • scaled graph screen and calibrating voltage source for direct reading of peak-to-peak voltages • "plus-minus" internal sync...holds sync up to 4.5 Mc • shielded input cable with low capacitance probe included • weighs only 14 pounds • includes built in bracket to hold power cord and cables.

SPECIFICATIONS: Vertical Amplifier (Narrow Band Position)—Sensitivity, 3 rms mv/inch; Bandwidth, within —3 db, 20 cps to 150 Kc • Vertical Amplifier (Wide Band Position)—Sensitivity, 100 rms mv/inch; Bandwidth, within —3db, 5.5 cps to 5.5 Mc • Vertical Input Impedance—At Low-Cap cable input...10 megohms, 10 μμf (approx.); At Direct-cable input...1 megohm, 90 μμf (approx.) • Sweep Circuit—Sawtooth Range, 15 cps to 75 Kc; Sync, external, ± internal; Line Sweep, 160° adjustable phase.



RCA WV-77E (K)

VOLTOHMYST®

only $29.95* *(also available factory-wired and calibrated only $49.95*)*

Think of it—an RCA VoltOhmyst Kit at this low, low price! You get famous RCA accuracy and dependability, plus the easiest to assemble kit you've ever seen!

FEATURING: ohms-divider network protected by fuse • ultra-slim probes and flexible leads • sleeve attachment on handle stores probes, leads, power cord • separate 1½ volts rms and 4 volts peak-to-peak scales for accuracy on-low ac measurements • front-panel lettering acid-etched.

SPECIFICATIONS: Measures: DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges; AC Volts (RMS)—0.1 volt to 1500 volts in 7 overlapping ranges; AC Volts (peak-to-peak)—0.2 volt to 4000 volts in 7 overlapping ranges; Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment • Accuracy—± 3% of full scale on dc ranges; ± 5% of full scale on ac ranges • Frequency Response—flat within ± 5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14, and 40-volt peak-to-peak ranges • DC Input Resistance—standard 11 megohms (1 megohm resistor in probe).

*User Price (Optional)

See them all at your local RCA Test Equipment Distributor!

RADIO CORPORATION OF AMERICA

ELECTRON TUBE DIVISION HARRISON, N. J.

ELECTRONICS

Hints from a Transithusiast's Workshop

By MARTIN KLEIN

I HAVE worked with transistors for several years. During this time I have had to resort to many tricks and kinks to solve various problems. As I have found them useful, I am sure that many other experimenters and hobbyists will also find them helpful and time-saving.

Mercury batteries: To prolong the life and facilitate the use of mercury or other transistor batteries, try this trick. Clean the ends of the battery and strip the end of a piece of red wire and a piece of black wire (any colors will do so long as you know which is plus and which is minus). Now place these ends alongside the ends of the battery and tie them tightly with enamel wire or heavy thread. Check with a meter to see that the leads are making contact. Next, holding the wires, dip the whole battery in In-sulex or a similar heavy plastic tool dip. Remove the battery and let the plastic harden. When it does, the battery will be sealed in a moisture-proof case with handy color-coded leads. This is especially useful for the tiniest mercury batteries which are easily ruined by the heat of soldering.

Transistor sockets: If bent properly, transistor sockets fit into each other to form excellent subminiature plugs and jacks. The jack is wired exactly as an ordinary socket. The plug is another transistor socket with leads soldered carefully in place. These sockets are sold with as many as eight leads. They can also be used as subminiature switches by bringing the switch leads to the socket and shorting the corresponding pins (see Fig. 1). Here, plugging in the headphones turned on the unit. A little improvising could probably devise many other uses for these little sockets.

Saving transistor leads: If you have a transistor with fragile leads (this includes most of them) which you frequently push in and pull out of its socket, here's how to save yourself worry, money and trouble caused by broken leads. Using the previous kink,

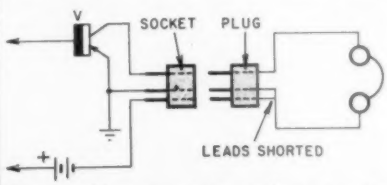


Fig. 1—How transistor sockets can be used as plug, jack and switch.

you can insert the transistor in a socket and tape it in place. Now the socket becomes the bottom of the transistor, and you can unplug and plug the unit to your heart's content without worrying about breaking the transistor leads.

Another way to protect transistor leads is to shape a small wooden block to the same size as the bottom of the transistor and about ¼ inch thick. Next drill three thin holes spaced as the transistor leads are spaced. Place the leads through the holes and glue the block in place with a nonpermanent glue such as rubber cement. Now if a lead breaks, it will break flush with the wood instead of the transistor. If this happens, remove the block and trim all the leads to the length of the shortest one. The transistor leads are still long enough for use in a socket.

Current measurements: Measuring the current on each transistor electrode in a circuit is done quickly and conveniently with the gadget shown in Fig. 2. You will need two transistor sockets, six tip jacks and three toggle or slide switches. One socket is used as a plug and the other holds the transistor. The latter socket along with the jacks and switches is placed on a panel. The switch of the lead whose current is being measured is left open while the other two are closed. The current meter is plugged into the jacks going to the lead under test. It is best to use a multimeter with this instrument since transistor current ranges from microamps to over an ampere for power transistors.

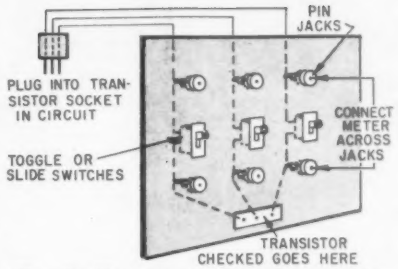

PIN JACKS
PLUG INTO TRANSISTOR SOCKET IN CIRCUIT
CONNECT METER ACROSS JACKS
TOGGLE OR SLIDE SWITCHES
TRANSISTOR CHECKED GOES HERE

Fig. 2—Test panel for measuring in-circuit current at transistor electrodes.

Broken leads: Once in a while, despite precautions, a transistor lead will break off flush with the case. It is usually possible to remedy this. Take a piece of thin copper or brass about 1/16 inch wide and put a small dimple in it near one end. Lightly file the bottom of the transistor. Now press the dimple on the tiny dot of metal showing at the bottom of the broken lead and tie the strip tightly to the transistor. Then test it to see if it has made contact with the exposed metal. If it has, cover the whole bottom with a thick coating of glue or tool-dip plastic. If it does not make contact, keep untying and tying until it does. The new lead will not be as sturdy as the original lead, but at least it will render the transistor usable. Unfortunately this method will not always work, but it is certainly worth a try. It will not work on metal-bottom transistors. If all attempts at fastening a new lead fail, you still may be able to use the two remaining leads as a diode.

Wire for transistor circuitry: A good supply of wire for miniature transistor circuitry can be obtained by purchasing several feet of No. 22 conductor telephone cable. This will give you many short lengths of strong, thin wire. You will also have wire of many colors to allow for color-coded leads.

Saving resistor space: When building one of those tiny transistor items, it is often annoying to have resistors take up so much space. You can solve this problem by standing them on end in groups. For instance, there are usually several resistors in a circuit which have a common meeting point. With all of them standing up and attached as a group, a lot of space can be saved. This will not complicate wiring too much if the unit is centralized. The same idea can sometimes be applied to the miniature capacitors in these devices. Just remember when miniaturizing that any empty space above a part is wasted space, so don't hesitate to stack components.

Well those are my ideas for now fellas. Hope you can use them. Good luck and happy semiconducting! END

New 4th edition now available!

The book that keeps growing in usefulness and popularity

It's here! The brand-new 4th Edition of General Electric's famous Transistor Manual . . . 227 pages jam-packed with vital information you need to keep abreast of this fast-moving and fabulous field.

You'll find 74% more information . . . new material on small and large signal characteristics, transistor radio servicing techniques and basic computer circuits . . . all the latest G-E transistor specs and a complete, up-to-date list of registered JEDEC types.

This is the one book in the transistor field you can't afford to do without! Get your copy from your General Electric Tube Distributor, or by mailing the coupon at right.

Partial List of Contents:

Basic Semiconductor Theory
Transistor Construction Techniques
Small Signal Characteristics
Large Signal Characteristics
Biasing
Audio Amplifiers
"Hi-Fi" Circuits
Radio Receiver Circuits
Transistor Radio Servicing Techniques
Switching Characteristics
Basic Computer Circuits
Logic
Unijunction Transistor Circuits
Silicon Controlled Rectifier
Tetrode Transistors
Power Supplies
Transistor Specifications
Rectifier Specifications

GENERAL ELECTRIC

General Electric Company
Semiconductor Products Dept., Section S60109,
Electronics Park, Syracuse, N. Y.

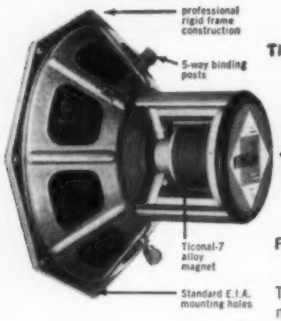
Rush me the new enlarged 4th Edition of the General Electric Transistor Manual. I enclose $1.00. (No stamps, please.)

Name_____

Address_____

City_____ Zone____ State_____

DEVELOPED AND GUILD-CRAFTED BY PHILIPS OF THE NETHERLANDS



THE NEW LINE OF *Norelco*®

T-7 LOUDSPEAKERS

FEATURING NEW TICONAL VIII® MAGNETS
(30% MORE POWERFUL THAN ALNICO)

This new line of 5" to 12" loudspeakers is designed to match the quality requirements of the discriminating music lover . . . at a surprisingly moderate price. The world's greatest buys on the basis of listening quality, the T-7 series incorporates voice coil magnets of Ticonal-7 steel, the most powerful of modern magnet alloys, for maximum efficiency and damping . . . dual cones for wide frequency response . . . constant impedance resulting in an extremely straight response curve . . . longer effective air-gaps and extra high flux density to provide exceptional transient response and to eliminate ringing and overshoot. For further descriptive literature write to the North American Philips Co., Inc., High Fidelity Products Division, Dept. 3E10, 230 Duffy Avenue, Hicksville, Long Island, New York.

A COMPLETE LINE OF SPEAKERS AND ACCOUSTICALLY DESIGNED ENCLOSURES

"My last wish? Shoot me with JENSEN NEEDLES."

SUITS NEED PRESSING— MERIT DEFLECTION YOKES DO NOT!

Merit deflection yokes are cosine wound TO FORM, not pressed. Pressing can lead to distortion and poor focusing. Pressing after winding frequently causes breakdown.

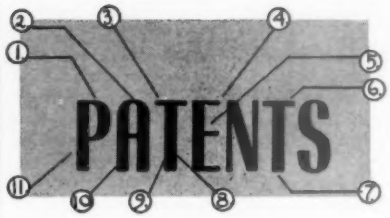
MERIT COILS AND TRANSFORMERS HAVE "BUILT-IN" ADVANTAGES.

Each Merit yoke is 100% LIVE TESTED

COMPARE IT WITH

MERIT

MERIT COIL AND TRANSFORMER CORP.
MERIT PLAZA • HOLLYWOOD, FLORIDA



NUCLEAR BATTERY

Patent No. 2,876,368

Alexander Thomas, Weston, Mass. (Assigned to Tracerlab, Inc., Boston)

This battery is made from an electret to which a radioactive isotope has been added. An electret is made of molten wax which is allowed to solidify in an intense electric field. When it reaches the solid state, the wax molecules remain polarized and the electret behaves much like a charged capacitor. Its charge can be maintained only across an open circuit, so the electret is not a source of *power*.

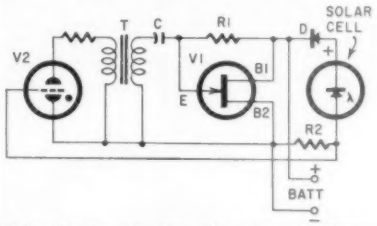
To produce steady power, this electret contains a radioactive isotope, which is mixed with the wax. Due to continual ionization, charged particles are available, and a continuous current can flow into the external circuit.

AUTOMATIC SOLAR-POWERED FLASHER

Patent No. 2,889,490

Maurice E. Paradise, Highland Park, Ill. (Assigned to Hoffman Electronics Corp.)

In this interesting application of solar power, a solar cell is combined with a storage cell (such as nickel-cadmium) to energize a flashing



light. During the day, the solar cell charges the battery and the lamp is extinguished. At night, the lamp is lighted by power from the battery.

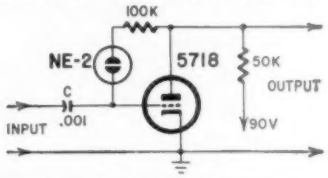
The solar cell can charge the battery, but the battery cannot discharge through the solar cell because of diode D. The battery energizes a double-base transistor (Unijunction) V1 connected as a self-oscillator. Transformer T steps up this ac and applies it across a triode gas tube V2. This tube flashes intermittently except when its grid is biased negatively. Note that this occurs only while the solar cell is charging the battery.

PULSE AMPLIFIER

Patent No. 2,890,295

Paul E. Murfin, Rochester, N.Y. (Assigned to USA, as represented by Secretary of Navy)

This low-frequency amplifier features high input resistance and minimum blocking time. Normally the neon tube remains dark. A



positive pulse at the triode grid increases plate current, and grid current begins to charge capacitor C. At the end of the pulse the grid reverses polarity because of the negative charge on C, and the tube *blocks. To maintain high input resistance the tube is operated without a grid leak.*

Now, there is a large potential across the neon lamp, one terminal being at negative grid voltage and the other at full positive, 90 volts (since the tube is blocked). The lamp fires, letting C discharge The capacitor starts to charge with opposite polarity (positive on the right terminal), causing full triode saturation. Tube voltage drops quickly and extinguishes the neon lamp.

SAVE 1/2 THE TIME

Make Twice The Profit!

in TV Trouble-Shooting

THIS EASY
SIGNAL INJECTION
POINT-TO-POINT
DIRECT VIEWING
WAY

MODEL 1075

B&K TELEVISION ANALYST

Solve Rough Sweep Output Problems

NEW Model A107
DYNA-SWEEP
CIRCUIT ANALYZER

Saves many hours of service work. Provides vertical and horizontal sync and driving pulses that enable you more easily and quickly to check out every stage in the sync and sweep sections of a television receiver.

Tracks down troubles in the horizontal and vertical output circuit including defective output transformer and yoke; checks for shorted turns, leakage, opens, short circuits, and continuity. Includes unique high-voltage indication. Eliminates trial and error replacements.

Model A107 Dyna-Sweep. Companion unit for use only with B&K Model 1075 Television Analyst for driving source.
Net, $49.95

Model 1070 Dyna-Sweep. Same as Model A107 but has its own horizontal and vertical driving pulse, and is used independently of the Model 1075.
Net, $69.95

New Technique Makes TV Servicing Easier, Faster, More Profitable

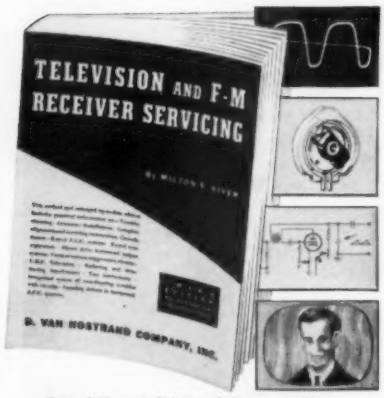
Thousands of service technicians already save thousands of hours every day with the amazing B&K TELEVISION ANALYST. Enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. Makes it quick and easy to isolate, pin-point, and correct TV trouble in any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—*including intermittents*. Makes external scope or wave-form interpretation unnecessary. Enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money. Color generator provides both rainbow pattern and color bars.

MODEL 1075 TELEVISION ANALYST. Complete with standard test pattern, white dot, white line, and color-bar slide transparencies, and one clear acetate. Net, **$259.95**

See your B&K Distributor or Write for Bulletin ST24-E

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 458 Broadway, New York 13, U.S.A.

NOW Service Any TV Set Like a "PRO"!



Brand-New Edition of Famous Shop Manual Will Lick "Tough Dogs," Save You Time, Increase Your Income 25% to 65%!

MAN, if you've ever cussed over a tough repair . . . if you've ever wanted more money . . . if you've ever wanted your business and reputation to grow . . . here's a powerful shove in those directions—the new *Television Receiver Servicing!*

Everything . . . and that means every new idea, every technique, every profitable practice . . . collected from little repair shops, part-time servicemen, big research centers . . . all the "red meat" of TV maintenance, repair and service has been collected into this big 300-page guide and manual.

Huge . . . Yet So Easy to Use!

You want quick facts on how to deal with tough antenna installations and ghost problems? Turn to Chapter 1 and get many field tested suggestions. What frequency should an antenna be cut to? Turn to page 6 and get 4 columns of clear explanation, with examples. What does an ideal video amplifier response curve look like? Page 127 illustrates it for you. What should you know about servicing *color television receivers?* Read the simple text from page 281 to page 300. Antennas (30 pages) . . . installing TV receivers (12 pages) . . . test equipment (27 pages) . . . RF, IF and video detector stages (45 pages) . . . video amplifiers (12 pages) . . . AGC systems (10 pages) . . . picture tubes, test patterns, deflection systems (83 pages) . . . receiver alignment (20 pages) . . . UHF . . . Color (32 pages) . . . there's even an easy-reference trouble-shooter's chart, and end-of-chapter questions, plus a complete, subject-by-subject index to put everything at your fingertips fast! With all this material, 421 pictures, 15 chapters, explained in A-B-C fashion, it's no wonder that TV Receiver Servicing is the "Bible" of the industry!

10-Day FREE Examination for Readers of Radio-Electronics Magazine

Use this for ten full days at our expense. Put its good sense to work on your toughest problems. If you're not 100% sure it's the biggest profit-making and time-saving friend you ever had, return it. You owe nothing. But mail coupon now. Once this printing is gone, it will take months to rush out another.

D. VAN NOSTRAND COMPANY, INC.
Dept. 1810, 120 Alexander St. Princeton, N.J.

Mail This for Free-Use Copy

D. VAN NOSTRAND COMPANY, INC.
Dept. 1810, 120 Alexander St., Princeton, N.J.
(In Canada: 25 Hollinger Rd., Toronto 16)

Please send me—for 10 days' FREE USE a copy of the new 4th Edition of **Television Receiver Servicing.** If I'm not completely sure it will increase my income by at least 25%, I'll return it within 10 days and owe nothing. Otherwise I'll pay $2.50 down, plus small delivery charge, then $2.00 a month for two months as full payment.

Name.....
Street.....
City..... Zone..... State.....

☐ **SAVE POSTAGE** by checking here and enclosing **$6.50 WITH** this coupon. Same return privilege, money back if not completely satisfied.

PATENTS *(Continued)*

The blocking interval is thus kept short, and the tube is ready for the next pulse.

RADIO PAGING SYSTEM

Patent No. 2,883,523

Francis P. Meserow, Chicago, Ill.

This system is suitable for hospitals, TV studios, etc. The desired area is wired with a loop around the ceiling or wall. The carrier, about 100 kc, is modulated and impressed on the loop. A tiny pocket-size receiver will pick up this signal on an earpiece for private listening so that other persons are not annoyed or bothered.

The inventor recommends a 4-tube circuit comprising 2 rf amplifiers, a grid-leak detector and an audio output. A transistor circuit could be designed to perform well, also.

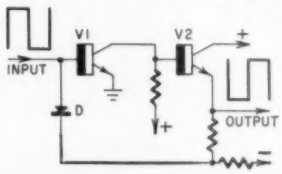
NONSATURATING SWITCH

Patent No. 2,887,542

Royer R. Blair, Berkeley Heights, and James R. Harris, Morristown, N.J. (Assigned to Bell Telephone Laboratories, Inc.)

In this switching circuit, diode D is normally blocked. V1 is cut off. V2's base is positive, so it conducts.

When a positive signal is applied to V1, it conducts and drives V2's base negative to cutoff.



In other circuits, a very large positive signal would drive the transistor to *saturation,* which is undesirable, because it leads to carrier storage effect. At saturation there are so many carriers in the semiconductor that considerable time is required to sweep them out. This delay in switching from on to off is avoided here.

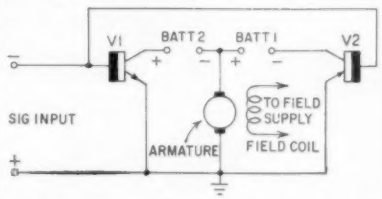
When the input goes highly positive, D conducts. This shorts out much of the input pulse and prevents saturation. Thus V1 can be blocked instantly if the input signal goes negative or is removed.

TRANSISTOR MOTOR CONTROL

Patent No. 2,875,391

Jack C. Brannan, Schenectady, N. Y. (Assigned to General Electric Co.)

This system can control a motor in either direction. V1 is n-p-n. V2 is p-n-p. The difference



in their collector currents flows through the motor armature. The motor will reverse direction when the armature flow reverses.

A negative signal produces more current in V2 than V1 and the motor will rotate in a given direction. A positive signal produces an opposite result. END

"I think I've found your trouble, Mrs. Grimly."

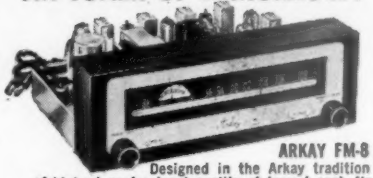
The Spotlight of Leadership is on...

arkay
Kits and Wired HI-FI STEREO

TODAY'S BEST *QUALITY* BUY

Acclaimed the finest by technicians and hi-fi enthusiasts who pass the word along . . . **"You get so much more with Arkay!"** . . . advanced engineering • exclusive new features • award-winning styling • matchless performance . . . at amazing low cost. Prove it to yourself. Ask your dealer for a demonstration.

FM TUNER OF TOMORROW!



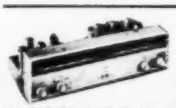
ARKAY FM-8
Designed in the Arkay tradition of highest professional quality at lowest cost. No other kit or wired component

OFFERS ALL THESE ADVANTAGES:
Variable AFC — no drift • tuning meter • silent tuning mute control • "standby" off-on switch • low frequency filter • level control • 3 tuned RF stages • dual limiters • Armstrong FM — Foster Seeley discriminator • hi-level, cathode follower and stereo multiplex output jacks • sensitivity, 1.9 uV for 20 db quieting • response, 20-20,000 cps ± ½ db • 8 tubes, selenium rectifier.
Cover $4.95
Wired and tested $59.95, Easy-to-build Kit **$39.95**

NEW! MUSIC MASTERPIECE

ARKAY CS-28
STEREO AMP/PRE-AMP
COMPLETE CONTROL CENTER
Full 28 watts stereo or monaural, 60 watts peak • 14 watts each channel • reverse stereo • balance control • two-channel gain control • full range bass and treble controls • IM distortion, 4 to 1 • harmonic distortion, 1% 30-20,000 cps • dual pre-amp 2V output jacks • speaker outputs, 4, 8, 16, 32 ohms • response, 20-20,000 cps • push-pull EL84 Williamson circuit • beauty of design that won Fashion Foundation's coveted Gold Medal! Many other incomparable features.
Wired and tested $99.95 Easy-to-build Kit **$64.95**

ARKAY CS-12
STEREO AMP/PRE-AMP
12 watts of clean power with dual inputs and outputs for excellent stereo reproduction • operates from ceramic or crystal cartridge, tape, tuners, auxiliary equipment • push-pull outputs for each channel.
Easy-to-build Kit **$36.95**



ARKAY ST-11 AM-FM STEREO TUNER
Here, for the first time, is an AM-FM STEREO Tuner within the reach of every audiophile. Unmatched by units costing twice the price, the ST-11 is two distinct receivers in one featuring 4 uV. for 20 db quieting. Variable AFC. Single front panel switch controls AM, FM or STEREO selection.
Wired and tested $74.50 Easy-to-build Kit **$49.95**

SPA-55 STEREO AMP 55 watts stereo-monaural, 27½ watts each channel. Wired $79.95 Kit **$64.95**

See and hear ARKAY Kits at your dealer.
FREE! Stereo booklet and catalog. Write Dept. A
All prices 5% higher west of Mississippi

arkay HIGH FIDELITY
88-06 Van Wyck Expressway Richmond Hill 18, N.Y.

Technotes

WEAK SIGNALS ONLY

An unusual complaint turned up recently when a battery radio was brought in with an intermittent. It worked all right on distant stations, but the local station failed to come in. In fact the radio went dead when a local broadcaster was tuned in. Voltage readings showed an intermittently open output transformer.

The audio output transformer had an open in the primary, which was just barely making a connection. On weak signals there wasn't much output, so the open still made a contact, but when the local station, which put out a signal several times stronger, was tuned in, the extra sound output opened the circuit.—*Alfred L. Hollinden*

COLOR-BURST TIMING

Not all color bar generators have the color burst located exactly as in a TV station transmission. When you run into this problem, it must be recognized and allowed for to insure good color sync.

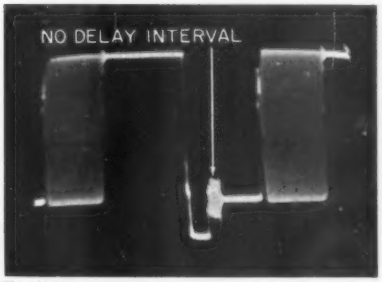


Fig. 1

As in Fig. 1, your color bar generator may supply the burst immediately following the sync pulse, with no space between. Or, the generator may provide a definite space here, with a late burst (Fig. 2).

The burst amplifier is gated. The timing of the gate pulses changes as the horizontal hold control is carried in one direction or the other. The tim-

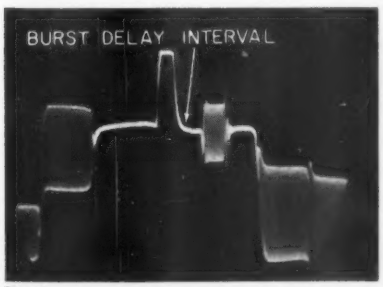


Fig. 2

YOU NEED THIS . . .
FREE GIANT ALL NEW 1960 BA CATALOG
A Complete Buying Guide for Everything in
RADIO TV ELECTRONICS 1960
ANNUAL CATALOG 601
BA
SINCE 1927
Guarantee
204 KING-SIZED PAGES
EVERYTHING IN RADIO TV AND ELECTRONICS
100'S OF NEW ITEMS LISTED HERE FOR 1st TIME
21 PAGES OF BARGAINS NOT IN ANY OTHER CATALOG
RUSH COUPON TODAY!
BURSTEIN-APPLEBEE CO. Dept. M,
1012-14 McGee St., Kansas City 6, Mo.
☐ Send Free 1960 B-A Catalog No. 601.
NAME
ADDRESS
CITY STATE

INSIST ON PROVED BRAND NAMES insist on the GENUINE "NOISE" big 3
Beware Of Cheap Substitutes!
NO-NOISE VOLUME CONTROL and CONTACT RESTORER
• Cleans • Protects • Lubricates
NOT A CARBON TET SOLUTION
2 Oz. Bottle $1.00 NET to Servicemen
6 Oz. Spray Can $2.25 NET to Servicemen
NO-NOISE TUNER-TONIC With PERMA-FILM
• Economical—a little does a lot.
• Cleans, lubricates, restores all tuners, including wafer type.
• Non-toxic, non-inflammable
• Use for TV, radio and FM
6 oz. Aerosol Can $3.25 NET to Servicemen
NOW AVAILABLE FREE AT YOUR JOBBERS
5" PLASTIC EXTENDER
With Push Button Assembly...For PIN-POINT APPLICATIONS
NO-NOISE RUBBER COAT SPRAY
• Insulates
• Waterproofs
• Protects
6 Oz. Spray Can $3.25 NET to Servicemen
ELECTRONIC CHEMICAL CORP. 813 Communipaw Avenue Jersey City 4, N. J.

HERE'S THE LIBRARY YOU NEED!

"101 WAYS" BOOK SERIES

by Bob Middleton

BEST-SELLING SAMS BOOKS®

NEWEST VOLUME

"101 Ways to Use Your Audio Test Equipment"

A practical, invaluable "how-to-do-it" book for audio test work. Describes uses of special instruments, such as harmonic-distortion meters, intermodulation-distortion analyzers, audio wattmeters, audio VTVM's and tone-burst generators; covers general uses of regular VOM's, VTVM's, scopes and square-wave generators in audio work. Each application is cross-indexed for quick location. 100% practical information for the professional audio technician and engineer; an important book for audio enthusiasts, too. Illustrated; 128 pages; 5½ x 8¼". Only..... $2.00

"101 Ways to Use Your Sweep Generator"

Covers full data on connections required for each application, proper test procedure, evaluation of results. Includes use of generator for checking and calibrating test instruments, antenna measurements, RF and IF alignment, special uses in color receiver tests, etc. Illustrated; 148 p.; 5½ x 8¼". Only..... $2.00

"101 Ways to Use Your Oscilloscope"

Fully covers standard and unusual uses; shows connections and equipment needed, proper procedures and how to evaluate results. Over 400 illustrations of wave-forms and test setups are shown. A "must" book for all scope users. 180 pages; 5½ x 8¼". Only..... $2.50

"101 Ways to Use Your VOM and VTVM"

Describes equipment checks; DC voltage tests; ohmmeter tests; signal-tracing tests; AC voltage tests; DC current tests; alignment applications; color TV tests. Covers all connections and equipment required for each test and how to perform it. Illustrated; 116 pages; 5½ x 8¼". Only..... $2.00

"101 Ways to Use Your Signal Generator"

Complete data on fullest use of this important instrument. Each application is fully and clearly described and illustrated. Includes proper procedures for antenna tests; AM-FM receiver tests; TV set tests; component tests. Illustrated; 128 pages; 5½ x 8¼". Only..... $2.00

ORDER THE COMPLETE LIBRARY

HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. K-29, 2201 East 46th St., Indianapolis 6, Ind.

Send me the following books:

☐ "101 Ways to Use Your Audio Test Equip." (TEM-5)
☐ "101 Ways to Use Your Sweep Generator" (TEM-1)
☐ "101 Ways to Use Your Oscilloscope" (TEM-2)
☐ "101 Ways to Use Your VOM and VTVM" (TEM-3)
☐ "101 Ways to Use Your Signal Generator" (TEM-4)

Name_____

Address_____

City_____ Zone____ State_____

(outside U.S.A. priced slightly higher)

TECHNOTES *(Continued)*

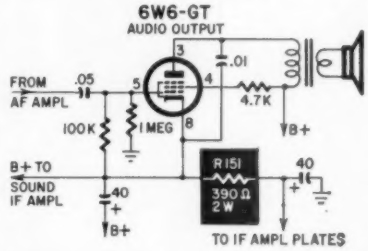
ing of the gate pulse must coincide with the burst to obtain good color sync lock.

When you set up a color receiver with an unknown color bar generator, make a preliminary test to determine whether a color TV program locks best with the horizontal hold control set at the same point as for best lock using the generator. This may or may not be so. Best lock point is determined by cutting down the antenna signal until confetti begins to appear in the picture. The color sync lock should be maintained with confetti present. Adjust the horizontal-hold control for best lock. With some color bar generators you can run into annoying callbacks unless discrepancies in burst timing are taken into account during installation.—*Robert G. Middleton*

CROSLEY 356-1

Complaint: Weak picture and sound or no picture or sound. Can be intermittent.

Reason: Low voltages in tuner, video



if stages. Caused by increase in resistance of R151 in the cathode circuit of the audio output tube. It should be 390 ohms, 2 watts.—*Harry C. Keller*

REPLACING SILICON RECTIFIERS

Most TV sets that use silicon rectifiers use a pair in a voltage-doubler arrangement. If either one of the two goes bad, replace both units as failure of one unit usually causes damage to the other. For a small additional cost, you protect yourself against a callback, and the customer against frequent repairs.—*C. S. Lawrence*

HOT-CHASSIS HAZARD

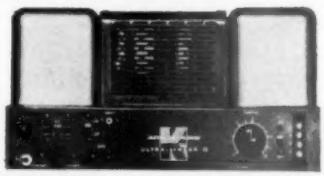
TV sets with the chassis connected to one side of the ac line can be a severe shock hazard. According to Underwriters Laboratories requirements, all metal parts that are exposed to the user must be insulated from the chassis. If you work on one of these sets, it is your responsibility to see that none of these safeguards is removed. Check tuner shafts, other front-panel control shafts, chassis mounting bolts, control escutcheons, picture-tube mounting brackets and frame and the interlock and antenna terminal board brackets. They should be insulated from the chassis, as they are exposed or in contact with the metal cabinet.

On some chassis, a high-value resistor and a parallel capacitor are connected between the insulated parts and the

leading audio magazines say . . .

FINEST QUALITY AMPLIFIER CAN BE ASSEMBLED BY YOU IN A FEW HOURS!

Acrosound Ultra-Linear II Amplifier Kits have astounded leading electronic exponents with their ease of construction and high quality performance. Quick and simple to assemble . . . no experience necessary. Lowers cost because you do it yourself! Follow the choice of experts — enjoy the ultimate in stereo sound, in your home now in a matter of hours!



ACROSOUND ULTRA-LINEAR II AMPLIFIER..... KIT $79.50

"With an output of 60 watts rated continuous power at an IM distortion of less than 1 per cent, this is an amplifier of highest quality . . . The entire construction operation should not require more than two hours by the most inexperienced."
December 1958—AUDIO

"As a result of careful predesign planning, the U-LII goes together in something under two hours. It represents a superb blend of constructional ease and superior performance, guaranteed to delight the most hard-to-please fanatic and the most dedicated music listener."
HIGH FIDELITY MAGAZINE
December 1958

"The construction is extremely simple since a printed board of basically the entire circuit is furnished. All that is really left to the constructor is the wiring of both the transformers and the controls mounted on the front panel. A new 60-watt amplifier kit that employs an unusual feedback circuit with exceptional stability . . . The total time required to build the kit is approximately 2½ hours."
RADIO & TV NEWS
October 1958

"The steps are few and the booklet and accompanying pictorial are clear and easy to follow . . . Test results . . . In the last and most important test, the amplifier sounded clean and performed beautifully at all volume levels."
POPULAR ELECTRONICS
March 1959

Write today for FREE *descriptive literature on all Acrosound Amplifier Kits.*

ACRO PRODUCTS COMPANY
369 Shurs Lane, Phila. 28, Pa.

ACRO . . . THE FIRST NAME IN AUDIO

chassis, to provide a leakage path for static charges while keeping them at rf potential. However, the resistance between the insulated parts and the chassis should never be less than 30,000 ohms.—*Larry Steckler*

MONTGOMERY-WARD MODEL GRX-4030A

Complaint: loss of video and audio.

If you run into one of these portables with this trouble, check the capacitor between the screen of the 6U8 (second if) and ground. It is a 1,000-$\mu\mu$f disc, but as temperature increases during set operation, its value drops to about 550 $\mu\mu$f. This is insufficient bypass for the 6U8 and the tube begins to oscillate.—*W. Shingler* END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In October, 1909, *Modern Electrics*

Combined Wireless Telephone and Telegraph Service, by Frank C. Perkins.

Construction of a Rotary Variable Condenser, by Bernadotte Anderson.

A (Wireless) Lecture Set, by Burt K. Bunch.

Thermo Battery in Wireless Work, by G. B. Sayer.

Wireless Telephone in the Navy by Frank C. Perkins.

Wireless Stations About New York: No. 3, Station at 42 Broadway.

Torpedo Run by Wireless.

The Automatic Operator, by O. A. Shann.

Improved Electrolytic Detector.

New Method for Producing High Frequency Oscillations.

New Method for Influencing Emitted Waves.

New Wireless Station in Spain.

From RSGB Bulletin, Mar. '59

"Well, I've shielded everything here but there's still a trace of hum."

EXTRA! the 1st time ...anywhere!

LEKTRON'S $1.00 POLY PAKS°

Pick Any **6 PAKs** for **$4.99**

Pick Any **12 PAKs*** for **$9.77**

FREE! 'Pik-a-Pak' free with any 12-Pak order!

POLY PAKS for a very LIMITED TIME at . . **88¢ EA.**

- ☐ **6 SILICON DIODES:** Sylv. 1N22, 1N23, Reg. $36 — 88c
- ☐ **57 POSTAGE STAMP MIKE:** crystal, 100-7000 cps. — 88c
- ☐ **70 ONE WATTERS:** asstd value carbons. 5% too — 88c
- ☐ **2 TRANSISTOR IFS:** doubled-tuned; ½" sq. 456 kcs. — 88c
- ☐ **4 OUTPUT XFMRS:** 50L6, etc. Reg. $8.00 — 88c
- ☐ **55 HEARING AID PHONE:** crystal, w/cord set & plug — 88c
- ☐ **30 ASSTD MOLDED CONDENSERS:** finest made — 88c
- ☐ **10 ELECTROLYTICS:** 10-500mf-450VDC. $12-val. — 88c
- ☐ **6 ROLLS TAPE:** plastic-fric.-rubber-cellophane — 88c
- ☐ **8 SUB-MINI SOCKETS:** mica-filled — 88c
- ☐ **10 POLY BOXES:** clear palstic, snap locks — 88c
- ☐ **8 GERMANIUM DIODES:** glass sealed, long leads — 88c
- ☐ **35 DISC CONDENSERS:** wafers, to 3000VDC. $5-reg. — 88c
- ☐ **20 PILOT LIGHTS:** mini bay, screw types, 2V to 6V — 88c
- ☐ **JEWELERS SCREWDRIVERS:** 5 sizes; submini work — 88c
- ☐ **35 TUBE SOCKETS:** 4-9 pin; $10-reg. — 88c
- ☐ **WIRE STRIPPER:** cuts #16 thru #22 hookup — 88c
- ☐ **2 NPN TRANSISTORS:** worth $15; used in radios — 88c
- ☐ **1500 pcs. HARDWARE:** nuts-screws-etc. $6-val. — 88c
- ☐ **60 CONDENSER SPECIAL:** molded, paper, ceramic, oil, mica, discs, variable. (2 lbs.) — 88c
- ☐ **70 HI-Q RESISTORS:** insulated, carbon; 1% too. ½ & 1W, 10 ohms to 10 megs. Reg. $13. (2 lbs.) — 88c
- ☐ **5 ROLLS MICRO-WIRE:** #24 thru #32; for transistor, sub-mini circuits. (1 lb.) — 88c
- ☐ **2 WUERTH SURGISTORS:** protects tube life in TV's. Simple to use, w/built-in 10-sec. time delay. Reg. $2 — 88c
- ☐ **2 SELENIUM RECTIFIERS: AC-DC,** 65 mil, 130VAC circuits. Mfd. by Federal. (1 lb) — 88c
- ☐ **2 "FLEA" POWER MOTORS:** 1½ to 6VDC; powered by penlite cells. Perm. magn. Size: 1¼ sq., 1" shaft — 88c
- ☐ **40 "SILVER" MICAS:** finest made condensers; 1 to 5% asstd values, axial leads. Reg. $25. Some $3 ea. — 88c
- ☐ **$15 SEALED RELAY:** used in jets; glass-sealed. 3PST cont. 6VDC coil. For precision circuits. (1 lb.) — 88c
- ☐ **20 HI-Q MOLDED OILS:** condensers used in finest commercial-gov't eqpt; .1 mf to 1 mf to 600V. Reg. $40 — 88c
- ☐ **15 "SEALED" CIRCUITS:** built-in resistor-condenser coupling circuits for sub-mini work. Reg. $9 (1 lb.) — 88c
- ☐ **MINI GEIGER COUNTER TUBE:** dozens of radiation detection uses. 2" long, ½" dia. — 88c
- ☐ **30 POWER RESISTORS:** W.W. 5 to 50W to 10K. Vitreous too. Reg. $15.00 (3 lbs.) — 88c
- ☐ **5 RESISTOR SPECIALS:** W.W., precision, carbon, variable, miniature types. Worth $15 — 88c
- ☐ **$2.50 SUN BATTERY:** similar to famed B2M. 1" — 88c
- ☐ **HOBBY BENCH VISE:** steel; clamp type — 88c
- ☐ **10 VOLUME CONTROLS:** some w/switches. Reg. $8 — 88c
- ☐ **15 ROTARY SWITCHES:** assorted gangs. Reg. $12 — 88c
- ☐ **35 TWO WATTERS:** carbons; incl. 10% Reg. $12 — 88c
- ☐ **4 OSCILLATOR COILS:** mini; 650-1600 kcs. $4-reg. — 88c
- ☐ **7 SCREWDRIVER SET:** wall-rack, $3 val. — 88c
- ☐ **16-END WRENCH SET:** box-open, 15/64 to 7/16" — 88c
- ☐ **MOLDED TIP JACKS:** red; for multi-testers — 88c
- ☐ **50 PLUGS RECEPTACLES:** audio, battery. $7-reg. — 88c
- ☐ **15-PC. DRILL SET:** 1/16 thru ¼" x 64ths; — 88c
- ☐ **2 VARI-LOOPSTICKS:** 540-1500 kcs — 88c
- ☐ **70 TUBULARS:** paper, molded; .5mf to 1000V — 88c
- ☐ **$25 SURPRISE PAK:** large, radio-TV binding — 88c
- ☐ **60 TERMINAL STRIPS:** solder-lug, binding — 88c
- ☐ **40 HI-Q CONDENSERS:** NPO's too, Reg. $15 — 88c
- ☐ **20 ARTISTS BRUSHES:** 100% bristle. Reg. $2.50 — 88c
- ☐ **12-HR 'SPACE' CLOCK:** penlite cell pwr. $8-val. — 88c
- ☐ **5-IN-1 DRILL BIT:** reams, saws, copes, shapes, drills; use with hand or power drills — 88c
- ☐ **MINI-RADIO KIT:** loopstick, jacks, diode and instructions. Reg. $5. (1 lb.) — 88c
- ☐ **2 TRANSISTOR VARIABLES:** 1⅛" sq., 2" shaft. Dual 365 mmf. Reg. $3. (1 lb.) — 88c
- ☐ **40 SUBMINI CONDENSERS:** for transistor, printed circuit work. Reg. $7. (1 lb.) — 88c
- ☐ **40 PRECISION RESISTORS:** asst. carbon, W.W. 1%, ½, 1, 2W. Reg. $19. (1 lb.) — 88c
- ☐ **60 RADIO-TV KNOBS:** asstd. colors, insulation. Reg. $17, some $1 ea. (2 lbs.) — 88c
- ☐ **4 POWER WOOD BITS:** Hi-S steel, 3⅛, ½, ¾, 1", 5" long. For electric drills. Reg. $3 — 88c
- ☐ **300-FT. HOOKUP WIRE:** tinned, asstd. sizes, colors. Reg. $5. (2 lbs.) — 88c
- ☐ **8 RCA PLUG-N-JACK:** sets matched. For most popular amps, tuners, phonos — 88c
- ☐ **60 MICA CONDENSERS:** .00025 to .01 to 1200V. Silver too. 25 values. Reg. $28 — 88c
- ☐ **40 SUBMINI RESISTORS:** ¼" long. Asstd. values 1/5W to 10 megs. Reg. $6 — 88c
- ☐ **3 TRANSISTOR XFMRS:** submini size, 100's of uses, audio, etc. Reg. $10 — 88c
- ☐ **100 HALF-WATTERS:** asstd. value carbon resistors, incl. 5%. Reg. $12 — 88c

FREE! Write for giant bargain catalog—year's subscription

MINIMUM ORDER 2 paks per order.

ORDER BY BLACK-TYPE HEADLINES, i. e. 70 HI-Q RESISTORS, 88¢. State price with each item. Send check or M.O. including sufficient postage; excess returned. C.O.D. orders, 25% down; rated, net 30 days. INCLUDE POSTAL ZONE in address. (Canada postage, 48¢ 1st lb.; 25¢ ea. add'l lb.)

Surprise gift Free with every order!

LEKTRON 131 Everett Ave. CHELSEA 50, MASS.

The important November issue of RADIO-ELECTRONICS on sale October 27

CITIZENS' BANDERS & HAMS

New ultra sensitive field-strength meter and monitor. Tunes from 24 to 56 mc. Small size. Transistors give 100-μa meter sensitivity of ½ microamp.

Complete with special antenna **$23.50**

RF preamplifier for 10 and 11 meters. Brings in those unreadable stations. 25 to 30 db signal gain.

Kit complete with tube, wire and solder. Or wired and tested.

Kit—RFI ..... $ 9.00

Assembled—RFIA 12.95

Prices plus postage & tax. 30% deposit required with order; balance COD.

MARLO ELECTRONIC INDUSTRIES

Box 131 Staten Island 10, N. Y.

ENGINEERING

B. S. DEGREE IN 27 MONTHS

Prepare for unlimited opportunities of the Electronic Age! Students study engineering under accelerated program leading to B.S. degree in 27 mo.; or standard 4-yr program leading to B.E. degree in 36 mo. B.S. degree (36 mo.) in Math., Chem., Physics. Year-round classes. Comprehensive training in electronics, television, advanced radio theory and design, math., nuclear physics and elec. eng. Also prep courses. Low rate. Earn board. G.I. approved. Enter Dec., March, June, Sept. Catalog.

INDIANA TECHNICAL COLLEGE

1710 E. Washington Blvd., Fort Wayne 2, Indiana

Please send me free information on B.S. ENGINEERING DEGREE IN 27 MONTHS as checked.

☐ Electronics ☐ Chemical ☐ Aeronautical ☐ Civil ☐ Mechanical ☐ Electrical

B.E. DEGREE IN 36 MO. in: ☐ Electrical (Power or Electronics) ☐ Aeronautical ☐ Chemical ☐ Civil ☐ Mechanical ☐ Metallurgical

B.S. DEGREE IN 36 MO. in: Math. ☐ Chem. ☐ Physics ☐

Name.....

Address.....

IT'S FUN TO BUILD THE BEST!

STEREO 70

Superb dual 35 watt amplifiers using the finest quality parts and the most advanced circuitry for unsurpassed performance on all loudspeakers. Complete with all parts, cover, and detailed instructions enabling 5 hour assembly, **$99.95**

NEW STEREO PREAMPLIFIER

The famous DYNA preamp in stereo. Complete control facilities with utmost simplicity, integral power supply, 60 db gain from 3 stereo low level inputs, plus 4 high level inputs, exclusive DYNA blend control. Only 8 hours assembly time. **$59.95**

MARK III

The choice of the experts, and tops in every test. 60 watts of undistorted power, with unequalled stability on all pulse and square wave tests. Features Dyna Biaset for simplified adjustment. Just 3 hours to assemble. **$79.95**

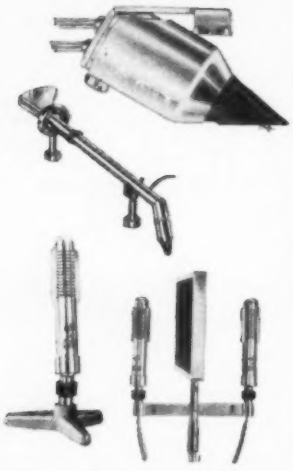
PREAMPLIFIER

The history-making "no distortion" preamp which has yet to be matched. Accurate equalization, minimum noise, only 0.05% IM, utmost flexibility, yet takes only 6 hours to build. **$34.95**

NEW MARK IV

A 40 watt analogy of the Mark III, similar to half the Stereo 70. 3 hour assembly with Dynakit's unique preassembled printed circuitry gives you uncompromised performance and utmost reliability. Charcoal brown and bright nickel to match other Dynakits. **$59.95**

dynakit DYNACO B&O



NEW STEREODYNE II CARTRIDGE

Without any equal for stereo or mono reproduction. Uniform high compliance (5×10^{-6}), minimum dynamic mass, high output, no hum pickup, no turntable attraction—everything for lowest record and stylus wear, plus the highest channel separation over the entire audio spectrum. With replaceable stylus. **$29.95**

NEW STEREODYNE ARM-CARTRIDGE

The STEREODYNE cartridge in its own optimum tone arm for unexcelled performance and unmatched convenience. Dynamic balance and gyro pivoting enable 2 gram tracking. **$49.95**

B&O MICROPHONES

The finest ribbon microphones made. Utmost versatility for the highest quality home and professional use. Ideally suited for stereo—the exclusive Stereo Spacer achieves remarkable ease of installation, with optimum separation and consistent balance. *B&O 50* (50 Ω) **$49.95** *B&O 53* (50 Ω, 250 Ω, Hi-Z) **$59.95** *Stereo Spacer* **$14.95**

Available from leading Hi-Fi dealers everywhere. Descriptive brochure available on request.

DYNAKITS MAY ALSO BE OBTAINED COMPLETELY ASSEMBLED AND TESTED — Prices slightly higher in the West

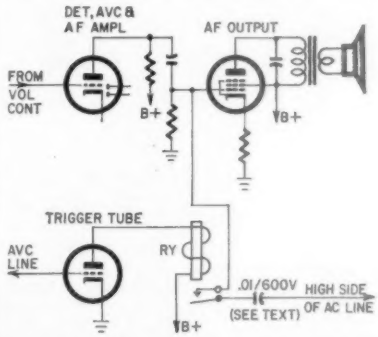
DYNACO INC., 3916 POWELTON AVE., PHILADELPHIA 4, PA.

CABLE ADDRESS: DYNACO • PHILADELPHIA, PA. • U. S. A.

NOTEWORTHY CIRCUITS

CIVIL DEFENSE ALARM

Many CD members build their own CD monitors by converting low-cost table-model radios. They merely add a relay and a control tube which is keyed by the set's avc voltage. One other item is required—a bell or buzzer to give the actual warning. If the bell or buzzer could be eliminated, the cost of the conversion could be greatly reduced.



To do this, use the radio's speaker as the alarm (see schematic). An ac signal is obtained from the high side of the ac line and is fed to one of the relay contacts by a capacitor. When the relay is energized, it applies the ac signal to the grid of the audio output tube. This produces a loud 60-cycle buzz from the speaker, which serves as an excellent alarm.

The radio's volume control has no effect on the alarm signal as it is in the grid circuit of the preceding stage. The coupling capacitor I used was a .01-μf 600-volt unit, but the value chosen should be one which produces the required buzz level.—*Albert J. Krukowski*

IMPROVED METAL LOCATOR

After building Edwin Bohr's metal locator (March, 1958, issue, page 62), I ran into trouble—not enough gain. I used CK768's in both oscillators and,

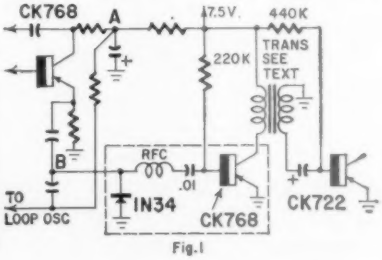


Fig. 1

having only a few CK722's and a 2N170 left, I tried a CK722 in what may be called the mixer (see Fig. 1). Very little signal was passed. I tried the rf 2N170 (an n-p-n unit) and the gain improved. As I still wanted a little more gain, I tried a 1N34 diode as a

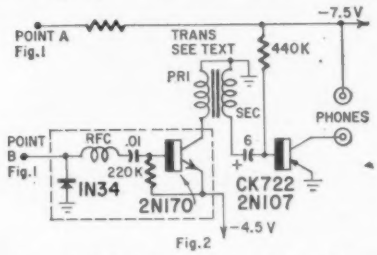


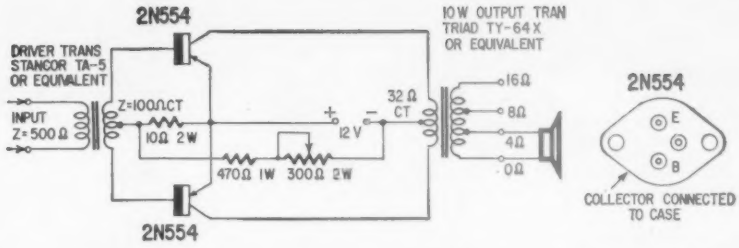
Fig.2

mixer and found that an rf transistor was still the best bet.

By using the rf transistor, I did get enough gain so that only two audio stages were needed following the diode. In Fig. 2 you can see how I used transformer coupling to increase gain further. A vertical blocking oscillator transformer was handy, and it worked. I used the highest impedance side in the collector circuit.—*W. G. Eslick*

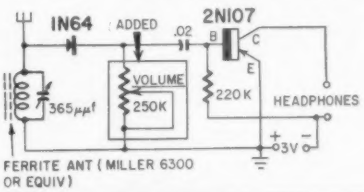
PUSH-PULL AUDIO AMPLIFIER

This amplifier delivers 5 watts with 10% or less total distortion. Power gain is approximately 20 db and the current required from the power supply varies from approximately 200 ma at no signal to about 1 ampere at full output. Input and output transformers are selected for good matching and performance at reasonable cost. (The driver transformer specified has a 1,000-ohm primary and 200-ohm secondary but is suitable here.)—*Motorola Semiconductors*



IMPROVED TRANSISTOR SET

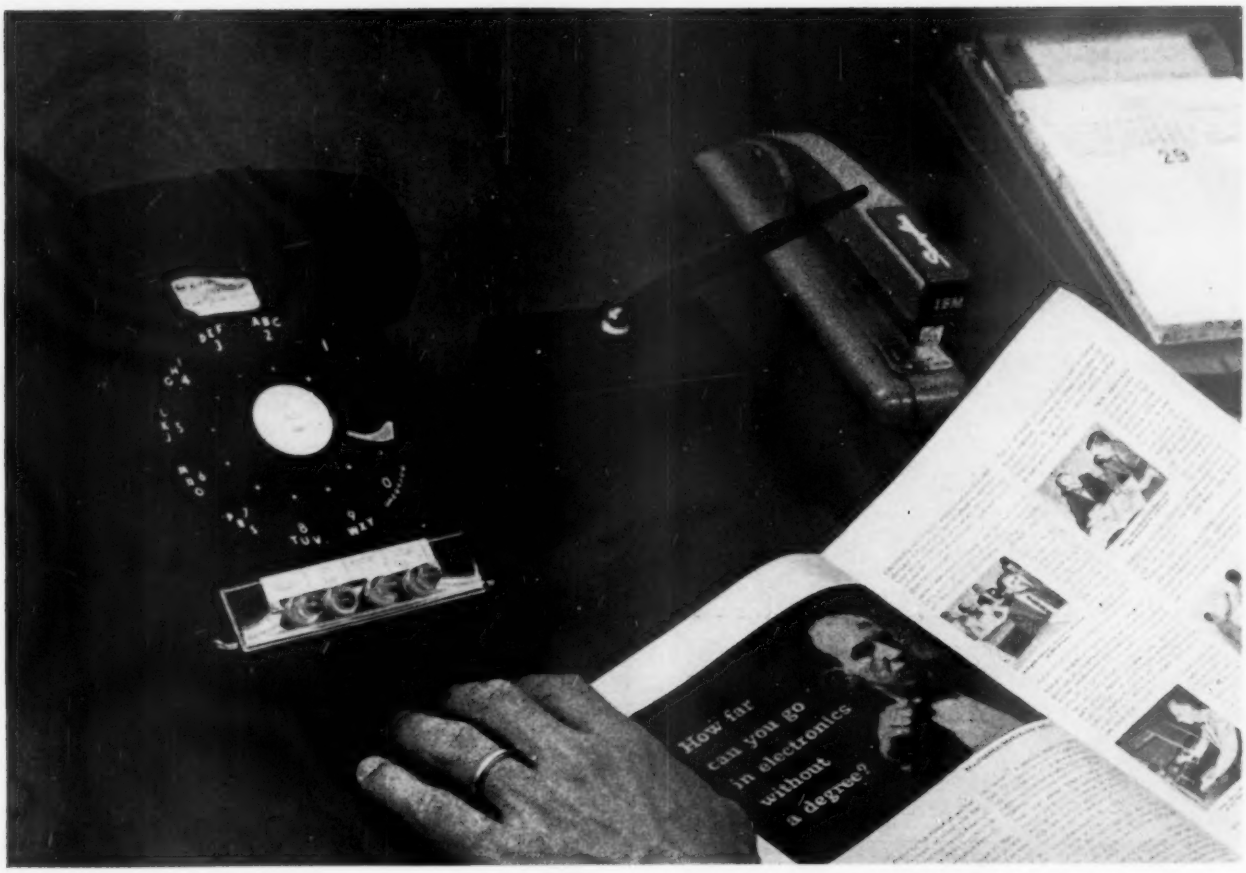
I began fooling around with simple transistor receivers a while back and haywired a circuit that came with the transistor I was using. The set worked a little too well—it played too loud and needed some kind of volume control. I tried a couple of arrangements and ended up by connecting a 250,000-ohm volume control as in the diagram. As well as a volume control, I got an increase in volume and the output now drives a small speaker. Also, some distortion is eliminated with this arrangemen.—*G. Etherington* END



SYRACUSE HAM FEST

On Oct. 10 the Syracuse Vhf Club will hold its fifth annual *Vhf Roundup.* There will be food, prizes and entertainment along with a full schedule of events for amateurs and their wives. Any ham may participate by contacting club president R. C. Stewart, K2PKL, for preregistration, at 114 E. Newell St., Syracuse, N. Y.

MICRO
ELECTRON TUBE
INTRODUCES FOR THE FIRST TIME ANYWHERE A SELECT STOCK OF USED TUBES AT FABULOUS LOW PRICE
37¢ ea.
FOR any TUBE LISTED
Jan Surplus Tubes!
$35 PER HUNDRED ASSTD.
ALL TUBES SENT POSTAGE PAID
Please send 25c handling for orders under $5. Send 25% deposit on C.O.D. orders. Send approximate postage on Canadian and foreign orders.
● Each and every tube is tested in our own laboratory for mutual conductance and life test.
● We guarantee FREE replacement for one year of any tube purchased from us which fails to function efficiently under any or all operating conditions. Prompt refunds are made on any defective merchandise.
● The advertised tubes are not necessarily new, but may be electrically perfect factory seconds or used tubes—each is clearly so marked.
0A2 0Z4 1A7GT 1B3GT 1H4G 1H5GT 1L4 1L6 1N5GT 1Q5GT 1R5 1S5 1T4 1U4 1U5 1V2 1X2 2A3 2AF4 3BC5 3BN6 3BZ6 3CB6 3CF6 3CS6 3LF4 3Q4 3S4 3V4 4BQ7A 4BZ7 5AS8 5AT8 5AV8 5AW4 5BK7 5J6 5T8 5U4G 5U8 5V4G 5V6GT
5X8 5Y3GT 5Y4G 6A7 6A8 6AB4 6AC7 6AF4 6AG5 6AQ7 6AH4GT 6AH6 6AK5 6AL5 6AL7 6AM8 6AN8 6AQ5 6AQ6 6AQ7GT 6AR5 6AS5 6AT6 6AT8 6AU4GT 6AU5GT 6AU6 6AU8 6AV5GT 6AV6 6AW8 6AX4GT 6AX5GT 6B8 6BA6 6BC5 6BC8 6BD6 6BE6 6BF5 6BF6 6BG6G
6BH6 6BJ6 6BK5 6BK7 6BL7GT 6BN6 6BQ6GT 6BQ7 5BY5G 6BZ6 6BZ7 6C4 6C5 6C6 6CB6 6CD6G 6CF6 6CG7 6CL6 6CM6 6CM7 6CN7 6CS6 6CU6 6DE6 6DQ6 6F6 6H6 6J4 6J5 6J7 6K6GT 6K7 6K8 6L7 6N7 6Q7 6S4 6S8GT 6SA7 6SC7
6SF5 6SF7 6SJ7 6SK7 6SL7GT 6SN7GT 6SQ7 6SS7 6T4 6T8 6U8 6V6 6W4GT 6W6GT 6X4 6X5 6X8 6Y6G 7A4/XXL 7A5 7A6 7A7 7A8 7B4 7B5 7B6 7B7 7B8 7C4 7C5 7C6 7C7 7E6 7E7 7F7 7F8 7H7 7N7 7Q7 7X7/XXFM 7Y4
7Z4 12A8 12AQ5 12AT6 12AT7 12AU6 12AU7 12AV6 12AV7 12AX4GT 12AX7 12AZ7 12B4 12BA6 12BA7 12BE6 12BF6 12BH7 12BQ6 12BR7 12BY7 12CA5 12J5 12K7 12L6 12Q7 12SA7 12SG7 12SJ7 12SK7 12SN7GT 12SQ7 12V6GT 12W6GT 12X4 12Z3 14A7/12B7 14B6 14Q7 19 19AU4GT
19BG6G 19J6 19T8 24A 25AV5 25BQ6 25DN6 25L6GT 25W4GT 25Z5 25Z6 26 35A5 35B5 35C5 35L6GT 35W4 35Y4 35Z5GT 37 39/44 42 43 45 50A5 50B5 50C5 50L6GT 50X6 56 57 58 71A 75 76 77 78 80 84/6Z4 117Z3 117Z6
SEND FOR OUR FREE COMPLETE LIST OF TUBES & SPECIAL PURPOSE TUBES
MICRO ELECTRON TUBE CO. P.O. BOX 55 Park Station, Paterson 3, N. J.



How far can you go in electronics . . .

Two years ago, Field Engineer William G. Miles was asked to outline *his* thinking on how far he could go in electronics at IBM . . . without a degree. Now, he reviews the progress he's since made. His present position: Group Manager, responsible for keeping one of America's largest electronic computers in top operating condition. Here's his story.

HURDLING THE DEGREE BARRIER. "A few years ago," recalls Bill Miles, "I felt that I'd gone about as far as a technician could without a degree. I just couldn't hurdle that education barrier. Now, thanks to IBM, I have a solid electronics education. I'm a Group Manager on the SAGE project, responsible for 20 field engineers. My future looks brighter than it ever did. I don't know of another company where a technician can go farther or receive more recognition, without a degree, than at IBM."

UTILIZING HIS NAVAL TRAINING. Bill Miles spent three years as a Naval Aviation Radar Technician. After discharge from service, he worked as a TV serviceman, at the same time pursuing an engineering education at night. "I knew there were good career opportunities around somewhere, but I couldn't find them," Bill Miles says. "I investigated several big companies. They were impressed with my ability, but my lack of a degree kept me from the kind of a career I wanted. Then I answered an ad similar to this."

EXTENSIVE ELECTRONICS SCHOOLING. In May, 1955, he joined IBM and began an extended training course. "The teaching was as technically advanced as I could ask for. Each day, I gained a deeper knowledge of electronics and added to my professional stature. IBM shows real interest in you as an individual: what your goals are, what plans you've made to reach your goals, how the company can help speed you toward them or even higher goals."

ASSIGNED TO SAGE SITE. After his training, Bill Miles was assigned to a SAGE site. SAGE is an important link in America's air defense, and the heart of SAGE is a real-time computer made by IBM. The SAGE computer analyzes radar data with uncanny accuracy, checks it against available air traffic information, and presents visual displays to assist the Air Force in identifying flying objects as friend or foe.

UPGRADING TECHNICIANS. "The job of IBM field engineers is to keep SAGE computers running," he explains. "This involves maintaining, testing, and checking computer units. It means anticipating trouble before it occurs. The work turned out to be exactly what I was looking for. I had a chance to do work ordinarily done by graduate engineers . . . work usually denied to men without a degree. Of all the companies I know, IBM appears to be one of the few which upgrades technicians to levels of engineering responsibility . . . levels dictated not by your formal education but by your native talents."

MANY EDUCATIONAL OPPORTUNITIES. "SAGE field engineers have many opportunities for education beyond the 'basic' training, which lasts 20 weeks," says Bill Miles. "After a year or two in the field, they may be selected for further training to learn how the complete SAGE electronic computer system works. To

Bill Miles reviews two-year-old article about his IBM career.

without a degree?

keep up with the most advanced electronic developments, they may also attend classes during working hours."

RAPID ADVANCE TO GROUP MANAGER. In his four years with IBM, Bill Miles has received several promotions. He is now Group Manager at a SAGE site. "My advancement is an example of IBM's policy of promoting from within," he says. "The company is quick to recognize a man's contributions and quick to reward him. This means lots of opportunities for new men who show potential for advancement along clearly defined routes—both in the technical and managerial areas. There are no limits set on your future. Everything IBM has ever promised about advancement in field engineering, I've seen happen—either to me or to someone I know."

• • •

If you have a minimum of 3 years' technical schooling after high school—or equivalent experience—you may be eligible for 20 weeks' training as a Computer Units Field Engineer. While training, you receive full salary plus living allowance and overtime pay.

IBM is the leader in a field that offers you unlimited horizons. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

WRITE TODAY TO: **Mr. N. H. Heyer**
Dept. 649J
Federal Systems Division
IBM Corp., Kingston, N. Y.

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States.

Discussing counseling methods with personnel management.

Demonstrating how SAGE operating console works.

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

JSC ATLAS SUPERSONIC TV LEAD-IN WIRE

PROVED BEST BY INDEPENDENT LABORATORY TEST

J.S.C. ATLAS

300 OHM TV WIRE HAS

LOWEST db LOSS

Reputable independent laboratory tests prove conclusively that JSC Atlas Supersonic TV lead-in wire is actually BEST BY TEST. Compared with three popular competitive makes, JSC Atlas was determined lowest in db loss — all of which proves you are selling the best tv lead-in wire . . . at the lowest prices, on the market today.

ATLAS SUPERSONIC TV Lead-In Wire Is The "Plus" Line

★ Atlas TV Wire has lowest db loss!
★ Atlas heavier web has longer life, less stretch!
★ Atlas Wire strips easy, leaves no adhesions to wire!

PROOF POSITIVE ATLAS TV WIRE BEST BY TEST!
All RF checks @ 200 mc/s

	OHMS Z.	RELATIVE BETA β	db 100 ft. α	OHMS D.C. RESISTANCE PER FT. Ω
Wire X	285	.780	3.5	.0180
Wire Y	285	.775	3.1	.0175
Wire Z	290	.785	2.6	.0140
Atlas 100	300	.785	2.1	.0075
Atlas 125	300	.783	1.8	.0075
Atlas 150	300	.778	1.8	.0075
Atlas 175	300	.758	1.75	.0075

Write or Call For Sample Wire, Price Lists and Full Data

JERSEY SPECIALTY CO.
Burgess Place Mt. View, N. J.
Phone: OXbow 4-6200-1-2-3

UHF J.S.C. VHF

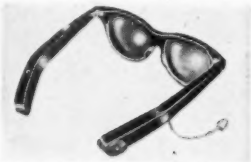
On the Market

ORGAN PARTS KITS. Consoles, keyboards, and other "specials" included, along with coils, chassis and *Organ Builders' Manual* which lists all special parts.—**Electronic Organ Arts,** 4949 York Blvd., Los Angeles 42, Calif.

LOW-COST INTERCOM system uses *model CHM6* as master for up to 6 stations, *model CHM12* up to 12 stations. Each has 3 amplifier tubes plus selenium rectifier, 5¼ x 10½ x 4¾ in. *Model CHR* remote stations

match masters, have call-initiating bar across full width of case. *Challenger* line systems handle all standard intercom situations. — **Bogen-Presto Co., Div. of Siegler Corp.,** Box 500, Paramus, N. J.

SUNGLASS RADIO. *FS-201 Specta-Radio* 3-transistor set has germanium diode and mercury battery. Volume and tuning controls entirely contained

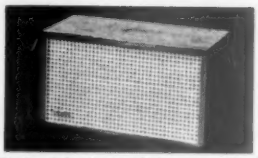


in frame of glasses.—**Lafayette Radio Corp.,** 165-08 Liberty Ave., Jamaica 333, N. Y.

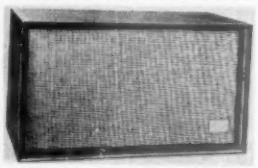
ECONOMY MICROPHONE *X-206* all-purpose crystal unit may be hand-held, used with clip-on desk stand, or as lavalier.

Response 65 to 10,000 cycles, output —55 db. 5 11/16 in overall.—**American Microphone Co.,** 412 S. Wyman St., Rockford, Ill.

3-WAY BOOKSHELF SPEAKER system *model XP-1* includes 12-in woofer, 5-in mid-range, 3-in tweeter, 3-stage crossover. Balance control allows adjustment of highs. Crossover frequencies 1,800 and 5,000 cycles. Response from below 30 cycles to beyond audibility. Handles up to 60 watts program material. Cabinet sealed, ¾-in wood, filled with Acoustiglass to eliminate resonances.—**Fisher Radio Corp.,** 21-21 44th Dr., Long Island City, N. Y.



COMPACT SPEAKER SYSTEM *Esquire 200.* 3 separate drivers; 12-inch woofer, 8-inch

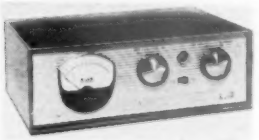


mid-range and diffraction horn compression tweeter. 12½ x 13½ x 24 in.—**Electro-Voice, Inc.,** Buchanan, Mich.

2-WAY 8-INCH SPEAKER *model SK-128* mounts 2-in tweeter off-center inside 8-in woofer. Level control for tweeter. Response 40 to 16,000 cycles. Cone resonance 45–65 cycles, depending on baffling. Rated 20

watts program material.—**Lafayette Radio, Corp.,** 165-08 Liberty Ave., Jamaica 33, N. Y.

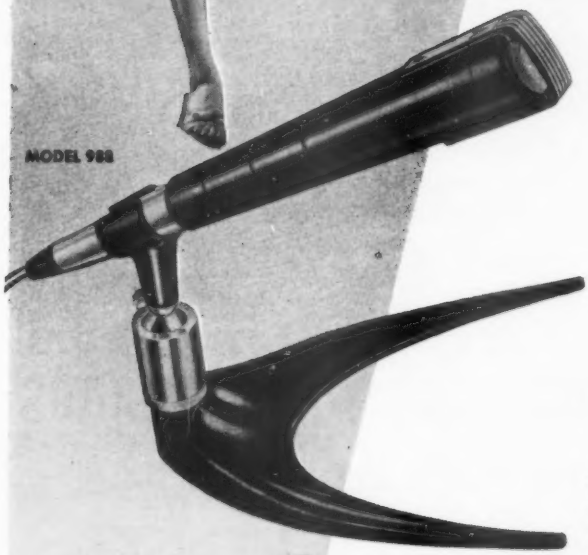
TAPE PREAMP *model TRP-11* for record and playback. VU meter, cathode-follower output, microphone input, recording-speed equalization switch. Response 50–15,000 within 3 db, output 5 volts, signal-to-noise



ratio over 50 db. Matches *series 900* tape decks. Use 2 for stereo. *Model TRP-21* for stereo record/playback similar to 2 *model TRP-11's* on 1 chassis. Other models for mono or stereo record, playback, or both available. —**Telectrosonic Corp.,** 35-18 37th St., Long Island City, N. Y.

FUTURA TRIPLETS...

three models... superbly styled... covering a wide range of applications



ASTATIC'S FUTURA

SERIES DYNAMIC MICROPHONES

Most versatile performers in the microphone field are the Astatic Futura Series Dynamic Microphones—Models Metro 788, Tempo 888, and Vogue 988. Beautifully styled, encompassing the newest and most advanced principles in microphone engineering, each model is designed to outperform any other microphone in its price class.

Futura mikes are instantly convertible from hand to stand to lavalier use... offer many special features such as rugged, stable, fatigue-free Mylar diaphragm and, on the 888 and 988, the Cannon XLR-3 connector for instant detachment from cable ("Take the microphone to the cable.")

Model No.	Type	Response	Output	Impedance	Finish and Trim	Price
788	Omni-Directional	60-13,000 cps	-55 DB	Hi or 150	Black and Gold	$ 79.50
888	Omni-Directional	50-15,000 cps	-56 DB	50, 200, Hi	Black and Chrome	110.00
988	Omni-Directional	40-20,000 cps	-58 DB	50, 150, 250	Black and Gold	150.00

NOTE — Exclusive Astatic impedance selector permits instant choice of impedance without special tools.

All three microphones come complete with lavalier and belt clip, 360° swivel adaptor for ⅝ #27 thread.

Twenty-foot, two-conductor, shielded cable supplied with each microphone.

THE Astatic CORPORATION, CONNEAUT, OHIO

In Canada: Canadian Astatic Limited, Toronto, Ontario
Export Sales: Roburn Agencies Inc.
431 Greenwich St., N. Y. 13, N. Y., U.S.A.

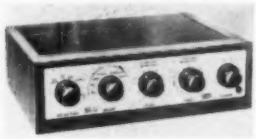
FROM WHAT YOU HEAR

ASTATIC MICROPHONES ARE A SENSATION ON ANY INSTALLATION

HI-FI PHONES *model HS-1*, extended-frequency moving-coil units. Response flat 150 to 11,000 cycles, useful 20 to over 15,000 cycles. Exceptionally sensitive with high power capability. 11

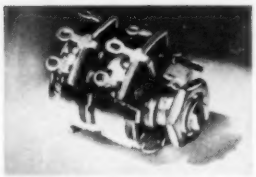
ohms. Separate conductors from each phone so 3-connector plug may be wired for stereo.—**Melody-Master Mfg. Co.**, 2842 N. Cicero Ave., Chicago 41, Ill.

ECONOMY STEREO AMPLIFIER *model AF-4*. 5 inputs, all medium level, plus 2 tape recorder outputs, stereo reverse, choice of channels for parallel



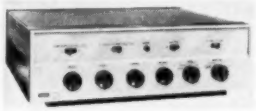
mono use, concentric clutched gain and tone controls. Output 4 watts per channel at less than 1% distortion; output impedances 4, 8, 16 and 32 ohms. Complete with metal cage. Factory-wired or kit.—**EICO** 33-00 Northern Blvd., Long Island City 1, N. Y.

STEREO BALANCE CONTROLS *type AD47* for single-



control balancing of 2 signals. Tandem-mounted pairs of 15/16-in ½-watt carbon potentiometers. As one control is increased, other decreased. Inserted at amplifier input or between preamp and amplifier. **Clarostat Mfg. Co.**, Inc., Dover, N. H.

STEREO AMPLIFIER *model A230* dual 15-watt unit includ-

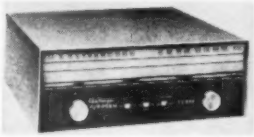


ing preamps. Friction-clutch type controls concentrically mounted to allow adjustment either independently or ganged. Usual stereo controls such as mode (mono, stereo, reverse, right and left). Also phono–radio selector; loudness, balance, bass and treble controls; loudness disable switch; 2 speaker switches (including switching of center speaker from left to right or off) and rumble filter switch. Optional metal cage.—**Harman-Kardon**, 320 Main St., Westbury, N. Y.

STEREO TUNER–PREAMP *model 690-A* complete control center with separate FM and AM tuning meters. Separate bass and treble controls for each preamp; gain, stereo bal-

ance, mode and selector on panel as well as loudness switch, AM narrow–broad switch, FM interstation muting switch, and automatic cutoff controllable by record changer. Front panel switch for choice of 2 magnetic phono inputs (changer and turntable). —**Pilot Radio Corp.**, 37-06 36th St., Long Island City, N. Y.

ECONOMY STEREO TUNER *model Challenger TC322* has built-in FM line antenna, built-in ferrite AM antenna, auto-



matic frequency control (AFC) on FM, 8 tubes, 1 diode. FM sensitivity 5 μv, AM 7 μv per meter (external antenna). Matching stereo amplifier *AC-220* includes two 10-watt push-pull amplifiers, provisions for

playing direct from any tape deck, separate bass and treble tone controls plus stereo reverse and other conventional controls. — **Bogen-Presto**, Box 500, Paramus, N. J.

CERAMIC STEREO PICKUP cartridge *model 10T* turnover type with 0.7- and 3-mil styli. Dual 0.7-mil tips and various combinations of sapphire–diamond. Entire cartridge pulled

out and new one snapped in when jewel tips wear out. Total cost comparable to ordinary styli. Response 20 to 15,000 cycles. Output conforms to RIAA curve with no equalization required. Rated ½-volt output.—**Sonotone Corp.**, Elmsford, N. Y.

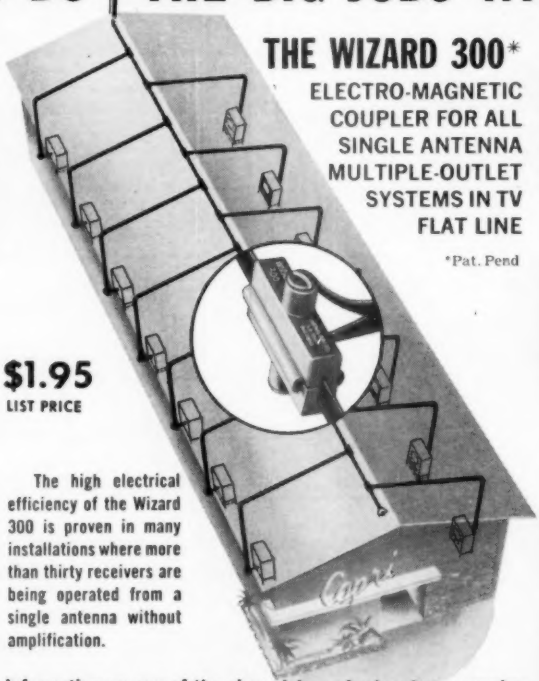
STEREO PICKUP STYLUS *Mk II T-Guard* in 2 models for Pickering stereo *Fluxvalves* for changers with tracking force of 3 to 7 grams or for transcription arms tracking at 2 to 5 grams. Improved compliance, higher output, better signal-to-noise ratio.—**Pickering & Co.**, Sunnyside Blvd., Plainview, N. Y.

STEREO MIXER TRANSFORMER for middle-channel speaker, *model XT-1* connects to outputs of stereo amplifier(s) to combine signals from both to

YOU CAN ALSO DO THE BIG JOBS WITH WIZARDS

HOME – 7 Outlets – One Antenna – No Amplification: Residence of Bob Barker, MC of the popular daytime NBC show Truth Or Consequences.

HOTEL – 120 Outlets–One Antenna–One Amplifier: The Montecito – 6650 Franklin, Hollywood, California.



THE WIZARD 300*
ELECTRO-MAGNETIC COUPLER FOR ALL SINGLE ANTENNA MULTIPLE-OUTLET SYSTEMS IN TV FLAT LINE
*Pat. Pend

$1.95
LIST PRICE

The high electrical efficiency of the Wizard 300 is proven in many installations where more than thirty receivers are being operated from a single antenna without amplification.

Information on any of the above jobs and a brochure covering Wizard System installations is available. Write Dept. RE-109.

CHARLES ENGINEERING, INC.
6053 Melrose Avenue • Los Angeles, California

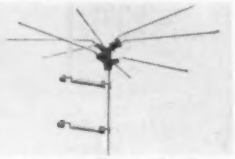
HOUSING PROJECT – 2,549 Wizards Installed To Date: L.A. Housing Authority, Los Angeles, California.

APARTMENT – 39 Outlets–One Antenna –No Amplification: The Del Rio – 10236 Old River School Road, Downey, Calif.

APARTMENT–48 Outlets–Two Antennas (24 Outlets each) – No Amplification: The Paramount Riviera – 12447 Paramount Blvd., Downey, California.

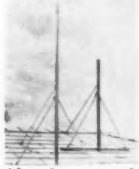
feed center-channel speaker. Designed for use with E-V *Stereon 200*, may be used with variety of speakers for program material up to 50 watts. Insertion loss from 1 to 3 db (for center channel).—**Electro-Voice, Inc.**, Buchanan, Mich.

FM ANTENNA LINE includes 8-element omnidirectional turnstile, dipole with reflector, 6-



element yagi. Turnstile *Stereocone* as attachment for mounting on present TV antennas or in full conventional mast form.—All antennas gold-anodized, factory-assembled.—**JFD Electronics Co.**, 6101 16th St., Brooklyn 4, N. Y.

UNIVERSAL MAST MOUNT for TV and FM antennas requires only hammer for erection, stands up to 100-mph



winds. Aluminum tubing secured with nail-screws with threadlike surfaces.—**Winegard Co.**, 3000 Scotten, Burlington, Iowa.

BATTERY TESTER *model WV-37B* tests radio batteries from 1.5 to 90 volts, reads replace, usable or good, as well

as exact percentage of rated voltage. Panel and switch have 8 blank positions for future voltages. Handles most transistor battery types and tube types.—**RCA Tube Div.**, 415 S. 5th St., Harrison, N. J.

WAVEFORM ANALYZER *model 850* uses phantom detector

probe—a small loop—to locate circuit difficulties without direct connection to circuits. Used with scope, analyzer displays waveform at any point in TV set. Loop is moved from one stage to next, slipped over tubes, or placed near coils. Tunable to channels 2–13, all if, video, radio and audio frequencies.—**Winston Electronics**, Inc., 4312 Main St., Philadelphia 27, Pa.

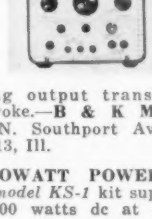
TUBE, BATTERY, VIBRATOR TESTER *model 13* has 5

storage drawers for tubes. Tube substitution, inventory and price guides in each drawer.—**Vis-U-All Products Co.**, 640 Eastern Ave., S.E., Grand Rapids, Mich.

TRACER-GENERATOR *model 802* high-gain audio amplifier

for signal tracing with both speaker and electron-ray indicator tube. In absence of signal, generates own 400 cycles for audio, modulated 455 kc for if checking, and 910 kc for AM rf stages. Either speaker or amplifier may be used externally for checking other components. Factory-wired or kit. **Electronic Measurements Corp.** 625 Broadway, New York 12, N. Y.

ANALYZER AND TESTER. *Model 550* low-cost dynamic mutual-conductance tube tester with common tubes listed on panel, complete reference chart in cover, supplementary charts issued regularly. Automatic line-voltage compensation built in. 7-pin and 9-pin straighteners on panel. *Model A107* Dyna-Sweep Circuit Analyzer (shown) companion unit to *model 1075* Television Analyst, provides vertical and horizontal sync and driving pulses for checking horizontal and vertical circuits, in-



cluding output transformers and yoke.—**B & K Mfg. Co.**, 3726 N. Southport Ave., Chicago 13, Ill.

KILOWATT POWER SUPPLY *model KS-1* kit supplies up to 1,500 watts dc at 1,500 or

BECOME A RADIO TECHNICIAN

For Only $22.95

By Jack Fudim

Today it is possible to become a radio technician without spending hundreds of dollars for an unnecessarily long and complicated Traditional Radio Course. Whether studied at home or at school, the Traditional Radio Course requires the student to pay dearly for every bit of knowledge imparted.

It is no wonder that a hundred thousand radio enthusiasts owe their basic technical training to the Progressive Radio "Edu-Kit." In 1946, when the "Edu-Kit" was first presented to the public, the response was immediate and positive approval of the new approach to home radio training. Developed and sponsored by a staff of engineers and educators, the Progressive Radio "Edu-Kit" quickly made its mark in the electronics field. During the past thirteen years, a new generation of radio technicians has been trained by this "Edu-Kit" method. Many of these young people could not have afforded the expense of a Traditional Radio Course. To these ambitious students, the "Edu-Kit" idea came as a light in the dark, offering a complete home radio education, priced so low that no one would be rejected from the field of electronics for lack of money.

Just what is the Progressive "Edu-Kit" idea? Based on a completely justified confidence in the intelligence and natural ingenuity of the average electronics-minded individual, the originators of the Progressive Radio "Edu-Kit" planned a radio course that would permit the beginning student to work and study independently in the privacy of his home or workshop. This radio course follows a natural and progressive pattern from simple to advanced work. It includes all necessary radio parts, tubes, tools, instructions. There is nothing else to buy, and no instructor is required. Yet this complete home radio course is priced so low that no interested person can afford to miss the opportunity it affords.

Specifically, the "Edu-Kit" radio course permits the student to construct and study sixteen interesting radio and electronics projects. The student begins by examining the various radio parts he receives. He learns the identification, symbol, function, theory, method of wiring of each of these parts. He learns how to solder. He is taught background theory, clearly presented, designed to develop his knowledge of electronics.

Then he builds his first radio. He enjoys listening to regular broadcast stations, practices testing, troubleshooting. This first set is very important because it sets the pattern for the student's habits and attitudes throughout his future career. Therefore this first set is designed to be simple to construct and to understand. An exact layout and pictorial is provided. But a standard schematic is also presented, and the student is taught to use it. This is a most important point, because the student will shortly be sufficiently skilled to construct complex radios by means of schematics alone, quite independently of pictures, pictorials, templates and other gimmicks. This skill is of tremendous importance, and clearly separates the technician from the tinkerer.

This first radio is not a mere "breadboard" toy, but a real chassis-constructed set, using standard wiring and soldering, instead of clips. How important this is will be realized later by the student. He must learn to layout his parts neatly and with precision. How unlike the sloppiness that is encouraged when "breadboards" are used! Modern educational practice discourages the out-moded procedure of teaching a skill that must later be untaught in favor of a better or more useful skill. The "breadboard-clip-template" method was discarded by "Edu-Kit" designers. The student learns to solder properly in the first place. Likewise he learns to work with parts located both atop and underneath the chassis, in a normal manner, rather than with all parts located on one side of a piece of wood acting as the chassis. He learns to count tube socket lugs properly, in a clock-wise direction, rather than improperly in a counter-clock-wise direction, as on a "breadboard." Briefly, the "Edu-Kit" is based on the idea that it is best to teach at once proper methods and habits, rather than teach poor habits which must later be unlearned.

The first set is followed by the second, then the third, etc., until sixteen are built. Gradually, and at a rate determined by the student, complex circuits are constructed, tested and studied. Each is designed to add some special knowledge or skill. To insure a proper breadth of background, a variety of circuits are included in the course. Not only are receivers built, but also a transmitter, a signal tracer, a code oscillator and a signal injector. Because of the recent widespread introduction of printed circuitry in the electronics industry, the student gains experience with this type of construction by building a printed circuit signal injector. This is in addition to the regular type of soldering and wiring he does on the other circuits. In this manner, the student gains a broad basis of experience for future work with important aspects of reception, transmission, test equipment, code. Various forms of detectors, oscillators, coupling methods, amplifiers are employed. FCC training, advanced topics in Hi-Fi, Radio and Television Repairs are also included. The prospective TV serviceman, radio amateur, experimenter, technician, engineer all find an excellent background in this course.

The "Edu-Kit" radio course was designed to satisfy the needs of everyone interested in electronics. Whether young or old, male or female, resident of a large American city or of a village in a distant land, each finds the "Edu-Kit" satisfactory. It is no accident that "Edu-Kit" students are to be found in almost every country of the world. The "Edu-Kit" can be truly said to have universal appeal. It is available in English or Spanish, designed for use on regular house electric power, whether 110 volts or 220 volts, AC or DC.

The "Edu-Kit" radio course has been taken by many thousands of students without teacher guidance. It is also included in the curriculum of schools ranging from the Junior High School to the College level. It is purchased by the U. S. Government for use in Veterans Administration hospitals and by the United Nations for distribution overseas. The "Edu-Kit" is widely accepted by Boy Scout, Church, Radio Club and similar organizations for group training, and is also extremely popular with members of the armed services stationed in military establishments in various parts of the world and aboard naval vessels on the high seas. The excellent reputation of the "Edu-Kit" is well-established. It is known as the foremost educational radio kit in the world.

The unique Progressive Radio "Edu-Kit" course is complete. Designed to give complete satisfaction to students living in isolated areas as well as in large cities, the "Edu-Kit" includes all necessary parts, tools and instructions. The course contains tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, instruction manuals, hook-up wire, solder, etc. In addition, the "Edu-Kit" contains Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. The "Edu-Kit" also contains a useful set of tools, a professional electric soldering iron and a self-powered Dynamic Radio and Electronics tester, as well as Code Instructions and the Progressive Code Oscillator, FCC-type Questions and Answers for Radio Amateur License Training. All these are the permanent property of the student.

A most welcome and useful service of the "Edu-Kit" radio course is its Consultation Service. Students are invited to write for free advice and consultation on all electronics problems. This service is without time limit. A lively correspondence is carried on regularly in English and Spanish with students all over the world.

A product of quality usually carries a guarantee. The Progressive Radio "Edu-Kit" carries an absolutely unconditional money-back guarantee. There is no time limit to this guarantee. If the student is not satisfied, and he is the sole judge, he may return the "Edu-Kit" for full cash refund. As a result, it can be truly stated that there is not a single dissatisfied "Edu-Kit" student in the world.

In addition to the regular parts and instructions which are part of the "Edu-Kit" radio course, a number of Free Extras are also provided. These include: set of tools, radio and electronics tester, electric soldering iron, tester instruction manual, membership in radio-TV club, Hi-Fi Guide, Quizzes, TV Book, FCC Amateur License Training, Radio Book, printed circuitry, pliers-cutters, alignment tool, wrench set, Certificate of Merit, valuable discount card.

Many satisfied students write to express their appreciation and report on their progress in electronics. Here are just a few of such letters: J. Stalaitis of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends and neighbors, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit." Ben Valerio, P.O. Box 21, Magna, Utah, writes: "The "Edu-Kits" are wonderful. I have been in Radio for the last seven years, but like to work with radio kits, and like to build radio testing equipment. I enjoyed every minute I worked with the different kits. The Signal Tracer works fine. I would also like to let you know that I feel proud to become a member of your Radio-TV Club." Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va., writes: "Thought I would drop you a few lines to say that I received my "Edu-Kit," and was really amazed that such a bargain can be had at such a low price. I have already started wiring radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the "Edu-Kit" is really sweit, and finds the trouble, if there is any to be found."

To those students ordering at once, a Free Bonus Resistor and Condenser Kit worth $7.00 is offered. Send check or money order for $22.95 as full payment, and the "Edu-Kit" will be shipped at once postpaid. Or order the "Edu-Kit" COD, and it will be shipped at once with understanding that $22.95 plus postage will be collected by the postman upon delivery. Further information regarding the "Edu-Kit" can be obtained free by writing to:

Progressive "Edu-Kits" Inc.

Progressive Building

1186 Broadway, Dept. 157G, Hewlett, N. Y.

NEW!

ALCO

20,000 ohms per volt

MULTITESTER

MODEL TS-60H

- High sensitivity—20,000Ω per volt
- Modern design
- Exceptionally wide scale arc
- Compares with 4½" meters
- Measures 3¼" wide x 4½" x 1¹⁵⁄₁₆"
- Compact, black bakelite cabinet

D.C. Volt Ranges — 5, 25, 250, 500 and 2500 @ 20,000Ω per volt

A.C. Volt Ranges — 10, 50, 100, 500 and 1000 @ 10,000Ω per volt

D.C. Current — 50μa, 25ma, 250ma

Resistance — 0-60,000 ohms, 0-6 megohms

Capacity — .001 mfd-.1 mfd (w/10 VAC supply) .0001 mfd-.001 mfd (w/100 VAC supply)

Decibels — —20db to +22db

$16.95 complete

ORDER DIRECT OR FROM YOUR NEAREST DISTRIBUTOR

ALCO ELECTRONICS MFG. CO.
Dept. H-1, 3 Wolcott Ave., Lawrence, Mass.

RECORDING TAPE

Premium Quality—money back guarantee

1200' Acetate 3 for $3.90 2400' Mylar 3 for $9.60
Lots of 10 any asst'ment—deduct 10%
Add postage 15¢ per spool

DON'T BUY HI-FI components, kits, tape recorders, until you get our low, low quotes by return mail. Wholesale Catalog Free.

ELECTRONIC WORLD
1799 1st Ave. New York 28, N. Y.

ON THE MARKET *(Continued)*

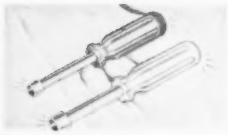
3,000 volts. Average dc 500 ma, peak 1,000 ma. Regulation better than 15% 0 to 500 ma, as high as 8% with typical linear

amplifiers. Ripple under 1%. Works on 115 or 230 volts dc. Fused. **Heath Co.**, Benton Harbor, Mich.

SWEEP-CIRCUIT TROUBLE-SHOOTER *model SS105* checks horizontal oscillator, horizontal output cathode current, deflec-

tion yoke, flyback transformer and vertical oscillator. Also serves as voltmeter, has adapter for substituting its deflection yoke without removing receiver yoke from picture tube.—**Sencore**, 112 Official Road, Addison, Ill.

HEX-NUT DRIVERS *Chrometone* (solid shaft) and *Gold-tone* (hollow shaft) lines, 31 drivers with colored plastic handles, for easy identification. Sockets tem-



pered to prevent "rounding-out."—**Vaco Products Co.**, 317 W. Ontario St., Chicago 11, Ill.

WIRE STRIPPER for any wire from 14 to 26 gauge is *Strip-Er-Clip* 7 positions adjust to varying sizes with thumb

pressure while in use. Insulated grip.—**G-C Div. of Textron, Inc.** 400 South Wyman St., Rockford, Ill.

PLASTIC-CASED CAPACITORS. *Polycaps* have outstanding humidity resistance, long life, high insulation resistance and low power factor. Solid im-

pregnant. Will be available as miniature paper-foil and metallized-paper capacitors. Also Mylar and electrolytic units.—**Aerovox Corp.**, New Bedford, Mass. END

All specifications on these pages from Manufacturers' data.

NEW MASTER ANTENNA SYSTEMS EQUIPMENT by entron

FEATURING AN ALL BAND AMPLIFIER

SA-23

High Power Output • 10,000 Hour Tubes • Long Life Silicon Rectifier • Separate Tilt and Gain Controls for Each Band

ANTENNA FILTER and FILTER BASE

AF-5

FB-7

Antenna Filter
Fixed Tuned Single Channel Design
Sharp Selectivity

Filter Base
Mixes Multiple Antennas
Designed for Mixing Non-Adjacent Channels in any Combination

SURFACE and FLUSH MOUNTING OUTLETS

OB-700 Series

OP-615

Response Flat from AM thru VHF Bands
Complete AC Isolation
Available in 75 and 300 Ohm Plug and 300 Ohm Screw Type

The Skill's Built In

entron INCORPORATED

For complete information send for Catalog F1102

FREE Send for booklet on Design and Installation of Master Television Antenna Systems

P. O. Box 287 Bladensburg, Maryland
APpleton 7-9585

FREE

350 BIG PAGES OF BARGAINS LIKE THIS

WRITE TODAY FOR FREE

12 MONTHS SUBSCRIPTION TO BARGAIN BULLETINS

Page-after-page, month-after-month. Exclusive bargains in HI-FI and LP RECORDS plus 1001 other items. To be "in-the-know" you must be on Radio Shack's mailing list. Just check the coupon below and mail it today!

SEND 35c FOR A COMPLETE GUIDE TO ELECTRIC PARTS BUYING

300 pages, 8½ x 11, illustrated handbook. Articles, engineering data plus buying guide. Over 40,000 items.

FILL IN -- CLIP -- MAIL TODAY

RADIO SHACK CORPORATION, Dept. 10E
730 COMMONWEALTH AVENUE, BOSTON 17, MASS.

Please send me

- ☐ Bargain Bulletins for 1 year FREE!
- ☐ 1960 Guide to Electronic Buying at 35c
- ☐ REALISTIC 40-W AMPLIFIER Order #90LX023 at $79.50*
- ☐ FREE Brochure on REALISTIC Line
- ☐ Check ☐ Money Order ☐ C.O.D. *Shipped by express only

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

NEW REALISTIC 40-W STEREO

OUTPERFORMS $140 AMPLIFIERS

$8 DOWN
$7 MONTHLY

$79.50 INCLUDING CABINET

$50 TO $90 LESS THAN COMPARABLE QUALITY UNITS

REALISTIC STEREOLYNE-40 AMPLIFIER Only REALISTIC could bring you this sensational value! Our buyers shopped the entire market. Our engineers made comparison test after test. All agree the REALISTIC-40 delivers more watts per dollar than any other stereo amplifier on the market today! Note that it's not a kit . . . the REALISTIC-40 is completely wired, and this amazing low price includes the cabinet . . . there's nothing else to buy! Read the specs. You'll agree it's one more reason why REALISTIC is America's best buy in HI-FI!

SPECIFICATIONS and FEATURES: Two 20-watt stereo channels or 40-watts monaural; 80-watts total peak audio output. Frequency Response: 20-20,000 cps ±1 db. Feedback: 20 db Less than 1% total R.M.S. harmonic distortion at 400 cps; hum level: -59 db on phono and tape head inputs; -79 db on tuner input at 20 watts output. Controls: individual bass and treble controls for each channel; balance control and phasing switch; single volume control adjusts both channels simultaneously; separate loudness switch; AC accessory outlet. Inputs: Tuner, Stereo Phono, Stereo Tape Head. Outputs: 4 /8 /16 ohms and Tape Recorder. 117 VAC, 50 /60 cycles. Size: 12" W x 4⅛" H x 9¹¹⁄₁₆" D. Custom-styled gold, maroon and white metal cabinet.

RADIO SHACK CORPORATION

167 WASHINGTON STREET, BOSTON 8, MASS.
730 COMMONWEALTH AVENUE, BOSTON 17, MASS.
230-234 CROWN STREET, NEW HAVEN 10, CONN.

REALISTIC... America's BEST BUY in HI-FI!

AMPLIFIERS | TUNERS | TURNTABLES AND TONE ARMS | ELECTROSTAT-3 TWEETER | SPEAKERS AND SPEAKER SYSTEMS

send for a FREE Brochure on the complete REALISTIC Line

For Checking Miniaturized Equipment, Pyramid's Model RC-1 New Resistance-Capacity-Ratio Bridge Tester. Budget priced . . . outstanding quality instrument . . . the RC-1 saves you both time and money. Precision-engineered, Pyramid's new model RC-1, Resistance-Capacity-Ratio Bridge Tester has a special low voltage bridge and stable vacuum tube amplifier for safe testing low voltage electrolytics such as commonly used in transistorized receivers.

Pyramid's RC-1, Resistance-Capacity-Ratio Bridge Tester is a functionally designed, sturdy, compact, lightweight unit, ideal for use by technicians, servicemen and engineers in radio, television (color as well as black and white), industrial electronics and all related fields.

PYRAMID MODEL RC-1 FEATURES:

- Special 3 volt amplifier for checking low voltage electrolytics used in miniaturized equipment such as transistor radios, etc.
- Capacity Ranges—from 10 mmfd. to 2000 mfd.
- Resistance—from .5 ohms to 200 megohms in 4 ranges.
- Ratio Test—provides quick reactance or resistance ratio between any two capacitors, inductors or resistors —range: .05 to 1 and 20 to 1. It can be used also to determine turns ratio of transformer windings within this range.
- Leakage Tests—handles all types of capacitors at rated voltages between 0 and 500V DC.
- Power Factor—0 to 60% (on capacitors from .1 mfd to 2000 mfd).
- Capacitor Test Voltages—variable between 0 and 500V DC in 17 steps.

PRICE: Dealer Net—$44.95

For further information about the RC-1 see your Pyramid distributor or write for complete technical data to: Pyramid Electric Company, Union City, N. J. EXPORT: 458 Broadway, N. Y. 13, N. Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal.

BURTON BROWNE/New York

PYRAMID
ELECTRIC CO.

TECHNICIANS' NEWS

TSA-MICHIGAN REJECTED

A letter signed by Frank J. Moch, executive Director of the National Alliance of TV and Electronic Service Associations was released as the reply of his national organization to the application of TSA-Michigan. It said in part, "We have processed your application and find that we cannot approve it. Under our constitution, we can recognize only one state group and only one local affiliate in each city. Since TESA-Michigan (formerly AMETA) has been duly recognized we cannot recognize TSA-Michigan. Also, since ESA of Detroit is the duly recognized local affiliate of TESA-Michigan we cannot recognize your group as an affiliate. . . . Membership for service business operators in all areas is invited by our local affiliate, regardless of what other group they may belong to. . . ."

Comment both approving and disapproving the decision of NATESA has appeared. Said *ARTSD News* (Columbus, Ohio), "This comes as a great shock to members of ARTSD, particularly those who spent many hours and dollars in the effort to bring [TSA] in. Apparently much time and effort has been uselessly spent in an attempt to unite, nationally the large, prominent and influential organizations. Regardless of what is said about unity, we find in many instances that the NATESA constitution will not permit it."

The *Guild News* (New York) agreed, ". . . It would seem that an association of such long standing and of such numerical strength would be such an asset to a national group that the leadership of that group, if they really wanted such a progressive association as a member, could find some way to work out details. Odd also is the fact that the announcement of TSA's intention to apply for membership in the spring was received . . . with open arms."

And an editorial in *The Raster* (Buffalo, Mo.): "What obstacles to complete service unity are ahead? . . . the only obstacle might be one of personalities . . . there are men now of great ability now pulling in somewhat opposite directions . . . we must have an orderly transition from our present state to that of unity. Associations cannot and must not be accepted into NATESA against the rules set up by NATESA. . . . Associations now in NATESA have certain rights which must be protected. NATESA cannot give in to the whims of its affiliating associations if they are not in harmony

with the PRESENT rules. This does not mean, however, that there should be no compromises made. . . . Hope that no one will block this unity movement because of prejudice or personal acquisitiveness."

TEXAS VIEWS

SARTA News (Texas Electronic Association of San Antonio) says, "One tremendous advantage that we service dealers have over factory service or part-timers is that we are able to service anything in the electronics field, thereby closing the door on the man who is strictly a tube changer, or the factory outfit that's tied to a single brand.

"Remember, the future holds great promise for those who prepare. You will soon find (electronic) air conditioning, heating, cooking, lighting and laundering (ultrasonic). There will be widespread use of closed-circuit TV, and videotape will enable people to record movies and TV programs and play them back. No other field of consumer products offers so wide a potential for service. . . . We must be willing to learn about these new products and train accordingly. . . . We must also cultivate the proper business procedures that will enable us to remain in business and grow. . . ."

TUBE CADDIES WILL SHRINK

A. P. Quackenschuster, noted economist, has predicted that by the late fall of 1967 there will be 7,856 receiving-tube types current, 86,516 transistor types and 189,564 kinds of fine-tuning knobs, all plastic. By early 1968, he foresees 1,870 fuse types, not counting 487 kinds of fusible resistors.

Seven new sorts of screwdrivers will be carried by top mechanics in addition to the present ones—straight split blade, six-sided Phillips, reverse Allen, obtuse Bristol, round clutch head, Kirby head and flathead.

By summer 1970, he predicts that the first plastic picture tubes will appear. Dr. Quackenschuster says these will be changed like a decal; just scrape off the old tube and press the new one into place, first wetting the paper backing and peeling it off. To convert from the popular 67-inch screen to the new 84-incher, the owner will need only to purchase the larger decal.

Asked if color TV would be perfected by 1970, Dr. Quackenschuster said, "No comment."—*TSA (Seattle) News*

LATE HOURS?

"Working hours, oddly enough, mean more than you'd think. Most people incline toward the feeling that anything that's easy to get can't be worth a lot. If you are on call 12 to 18 hours a day, your customers know that you don't set a very high value on your own time. After all, a TV set that's not working is not a major disaster. And if you have a reputation for doing top-notch work, you'd be surprised at how many people will wait until the

Transistor Radio Servicing CAN be Highly Profitable

The ONLY Complete Transistor Radio Service Lab

Everything you need for less than $50

Check Transistors, Diodes, Rectifiers . . .

SENCORE TRC4 TRANSISTOR CHECKER

Accurately checks all transistors in hearing aids, radios and power transistors in auto radios. Tests for opens, shorts, leakage, current gain. Measures forward-reverse current ratio on all crystal diodes. Measures forward and reverse currents on selenium rectifiers. With set-up chart for accurate checking of each transistor. Size, 5x4½x2½". With batteries. DEALER NET..... 17.95

Replace Batteries During Repair . . .

SENCORE PS103 BATTERY ELIMINATOR

All-new "Transi-Pak," twin to TRC4 Checker above. Provides variable DC voltage to 24 volts; 1.5-volt biasing tap (a "must" for servicing Philco and Sylvania radios). Metered current output, to 100 ma. Handles 200-ma peaks. Two 200-mfd electrolytics provide proper filtering and low output impedance. No hum or feedback problems. Ideal for alignment using station signal; adjust IF slugs for max. current, also ideal for charging nickel-cadmium batteries. Size, 5x4½x2½". DEALER NET..... 17.95

Find Defective Stage in a Minute . . .

SENCORE HG104 HARMONIC GENERATOR

New signal generator designed primarily for fast signal-tracing of transistor radio circuits. No need to unsolder all transistors. Provides RF, IF and audio signals *simultaneously*, drastically cutting service time. Traces from speaker to antenna. Clear 1000 cycle note signal is heard in speaker from all good stages. Signal weakens or stops at defective stage. Equally as effective for testing TV, hi-fi and other audio circuits also. Size, 3½x4½x1¾". With batteries. DEALER NET..... 9.95

Turn page for other SENCORE Time Savers

See your Parts Distributor NOW!

SENCORE

ADDISON 2, ILLINOIS

Automation

Good future in Electronics for men without a degree . . .

Electronic control of industrial processes is one of the fastest growing, most important fields in electronics today. Your own future may well lie in work with servo-mechanisms, computers, data processing equipment, closed circuit television or communication systems. There are not enough good engineering technicians. With good training in fundamentals, you can almost name your own terms.

Write for our free Career Information Material today or send the coupon on page 11.

CLEVELAND INSTITUTE OF ELECTRONICS DEPT. RE-341

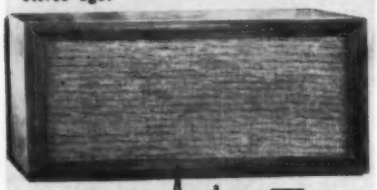
4900 EUCLID AVE., CLEVELAND 3, OHIO

NEW SOUND EXCITEMENT FOR THE HI-FI STEREO AGE!

Kingdom LORENZ

SPEAKER SYSTEMS

Keyed to stereo — priced for everybody — the all new Kingdom Lorenz speaker systems bring a fresh excitement to high fidelity listening, stereo or monaural. Never before has the hi-fi market seen so many quality features in advanced engineering and decorator beauty — making **Kingdom Lorenz the outstanding speaker value of the hi-fi stereo age!**



NEW! Audette III

A High Fidelity loudspeaker system of beauty, durability and thrilling "orchestrated" sound. Designed for stereo use in pairs — or singly for brilliant monaural. The famous Lorenz 8" woofer, quality tweeter and crossover, together with the principle of total damping, result in this perfected instrument of advanced engineering. Comes in a choice of elegant decorator woods, **finished on four sides,** for use horizontally or vertically . . . adapts beautifully to your personal decor. • 11" x 23¾" x 10" • 30-18,000 cps • 18 watts peak • 8 ohms.
Ready-for-finishing Birch.....$57.50
Oiled Walnut, Mahogany, Walnut, Blond or Ebony.....$64.50
Matching brass legs (for consolette style)..... 5.95

NEW! KAL AUDETTE

The famous Lorenz 8" loudspeaker with quality tweeter and crossover in a cabinet of high impedance port construction. An outstanding basic system — marvelous in pairs for stereo • 11" x 23¾" x 10" • 35-18,000 cps • 18 watts peak • 8 ohms.
Brown or blond leatherette.....$49.50
Matching brass legs..... 5.95

NEW! AUDETTE SR.

Superior infinite baffle construction for "big systems" performance. Mounts famous Lorenz 8" woofer and tweeter with crossover. Elegantly proportioned 4" legs • 22¼" x 22¼" x 10½" • 30-18,000 cps • 20 watts peak • 8 ohms.
Mahogany $69.50
Blond or Walnut..... 74.50

NEW! OMEGA I

A completely sealed and master engineered enclosure — contains the full spectrum Lorenz 12" woofer with two tweeters and crossover. **Completely finished on four sides** for use horizontally or vertically • 27" x 14¾" x 11½" • 18-18,000 cps • 40 watts peak • 16 ohms.
Ready-to-finish Birch.....$109.50
Oiled Walnut, Mahogany, Walnut, Blond or Ebony.....$119.50

At High Fidelity Dealers Everywhere.
FREE Catalog—Write Dept. RE

Kingdom PRODUCTS, Ltd.
514 Broadway, New York 12, N. Y. • WOrth 6-0880
Exclusive U. S. Distributors for Lorenz High Fidelity Loudspeakers

shop is open to get the best man in town to do their work. Sure there's an occasional call for night or Sunday service that you should make; invalids, the aged; we all try to take care of them.

"Ever try to locate someone to fix your car at night? Or get a plumber or electrician on Sunday? Sit down and figure what you get out of these night calls, remembering that if you were in the mill or factory you'd expect, and get, overtime pay."—*The Printed Circuit (Durham, N. C.) News*

ELECTRONIC TRAFFIC COURT

The "age of everything"—including "robot justice"—is in the offing. Suburban Dearborn (Mich.) is in a controversy over a proposed closed-TV circuit "drive-in courtroom" for Dearborn's new civic center. Cost for the electronically equipped courtroom with isolation booths would be around $400,000. It would permit paying tickets right from the car, meanwhile forcing the judge to leave his chambers and appear on his bench, in front of the closed-circuit TV camera.—*TSA-Michigan News*

18 COMPLAINTS IN 50,000!

Howard Wolfson, chairman of the Associated Radio & TV Servicemen (Chicago), writes about the show ARTS ran at the recent Chicago International Trade Fair: "We manned the booth with from 2 to 5 men every day for 17 days. We estimate that over 100,000 people stopped to look, out of the 850,000 who attended the fair. Many thousands engaged us in conversation. We had two Zenith sets, an RCA color set and Simpson test equipment going 12 hours a day. We answered questions all day long like 'What causes the white line in the middle of my picture?'

"We gave out more than 50,000 circulars explaining some of the expenses service shops have to carry, and 42,000 discount certificates good for $2 each at service shops. It cost ARTS members over $6,000 in time and money to run the exhibit. Most amazing to us was the fact that only 18 people stopped in to register complaints about radio–TV service technicians. This *must indicate that the public finds able servicemen, reasonable prices and few gyps!*"

DO YOU BELONG TO A SERVICE TECHNICIANS' ASSOCIATION?

For the benefit of service technicians and their organizations RADIO-ELECTRONICS is publishing a complete list of the known television service associations in this country and Canada. Due to the difficulty of contacting associations, our first lists will necessarily be incomplete and sometimes inaccurate. Service technicians can help us put out a complete up-to-date list. If you know of any association omitted from our list, or can correct any of the old listings,

one word more about the **Amperex 6CA7/EL34** *OUTPUT PENTODE*

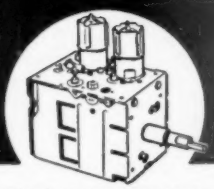
NOW ITS RATED POWER OUTPUT IS 60 WATTS (CLASS AB1)

We are pleased to announce that as a result of the further exploration of the 6CA7's capabilities . . . its power output rating has been raised to 60 watts in a distributed load circuit. This was achieved by increasing the screen grid voltage to 500V. The screen voltage rating now equals the plate voltage rating, thus greatly simplifying the design of power supplies.

ask your Amperex distributor about Amperex voltage amplifier, rectifier and output tubes for hi-fi circuits.

AMPEREX ELECTRONIC CORP.
230 Duffy Avenue, Hicksville, L. I., N. Y.

TARZIAN Offers 48-Hour, Direct Factory Service on Tuner Repairs



only $7.50

That's right. Net, $7.50 per unit and $15 for UV combinations, including ALL replacement parts. 90-day warranty against defective workmanship and parts failure. Tuners repaired on approved, open accounts. Replacements offered at these prices* on tuners not repairable:

VHF 12 position tuner . .	$22.00
VHF 13 or 16 position tuner.	23.00
VHF/UHF combination .	25.00
UHF only	15.50

*Subject to change

Tarzian-made tuners are easily identified by this stamping on the unit. When inquiring about replacements for other than Tarzian-made tuners, always give tube complement . . . shaft length . . . filament voltage . . . series or shunt heater . . . IF frequency and chassis identification. Use this address for fast, 48-hour service:

SARKES TARZIAN, Inc.
Att.: Service Mgr., Tuner Division
East Hillside Drive
Bloomington, Indiana

please write to: Association Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

This month we publish a list of known local associations in New York and Ohio. We will list locals in other areas in subsequent months. If there is a group near you, why not contact them. It's for *your* benefit. The person whose name appears with the listing of the association is the correct one to contact.

To learn of the association nearest you *now*, drop a postcard to: Association Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

EMPIRE STATE FEDERATION OF ELECTRONIC TECHNICIANS ASSOCIATIONS
19 West Cowden Place
Jamestown, N. Y.
George Carlson, Secretary

TELEVISION SERVICE ASSN.-ALBANY
112 Central Ave.
Albany, N. Y.
Phillip Di Pace, Director

RADIO TV GUILD OF LONG ISLAND
Box 87
Bethpage, N. Y.
Robert Larsen, President

SOUTHERN TIER CHAPTER-RSA
Box 201
Binghamton, N. Y.
Michael Harris, Secretary

ASSOCIATED RADIO TV SERVICEMEN OF N. Y.
1257 Bedford Ave.
Brooklyn 16, N. Y.
Edward Eisen, President

TV & ELECTRONIC SERVICE ASSN. OF BUFFALO
703 Main St.
East Aurora, N. Y.
Irving J. Toner, President

RADIO TECHNICIANS ASSN. INC.
694 Broadway
Buffalo, N. Y.
Ted Telaak, President

MOHAWK VALLEY RADIO TV TECHNICIANS GUILD
20 Allman Place
New Hartford, N. Y.
Frank Kurowski, President

TOMPKINS COUNTY ELECTRONIC DEALER'S ASSN.
440 State St.
Ithaca, N. Y.
Ben De Young, President

ELECTRONIC TECHNICIANS ASSN.
201 East Third St.
Jamestown, N. Y.
Malcolm Nelson, President

ROCKLAND ASSN. OF TV & ELECTRONIC SERVICES
55 E. Central Ave.
Pearl River, N. Y.
Larry Critchlow, Secretary

TRI-COUNTY ELECTRONIC TECHNICIANS ASSN.
28 South Main St.
Portville, N. Y.
Jack Golden, Secretary

TV & ELECTRONIC ASSN. OF ROCHESTER
536 Jay St.
Rochester 11, N. Y.
Peter Ferrari, President

SYRACUSE TV TECHNICIANS ASSN.
410 Florida Rd.
Syracuse, N. Y.
Daniel Hurley, President

TV TECHNICIANS ASS'N. OF TONAWANDA
1032 Nash Rd.
North Tonawanda, N. Y.
Don Clark, Secretary

ULSTER ELECTRONIC TECHNICIANS ASSN.
94 Furnace St.
Kingston, N. Y.
Charles Kahl, Secretary

ELECTRONIC TECHNICIANS ASS'N WATERTOWN
1830 State St.
Watertown, N. Y.
John Thompson, Director

STEA—ELMIRA
RD #1—Pine City
Hendy Hollow Rd., Elmira, N. Y.
Ernest Scott, Director

END

Servicemen! SAVE TIME . . . SUBSTITUTE THE SENCORE WAY

The Fastest, Surest Method Known!

Substitute for Capacitors, Resistors

SENCORE H-36—THE "HANDY 36"

36 most-often-needed resistors and capacitors, for fast, easy, direct substitution in all circuits. ● Eliminates searching for replacement components for test purposes. ● Avoids unnecessary unsoldering and soldering—no more solder mess. ● Pays for itself the first month in time saved. ● Flick of a switch instantly selects any one of . . .
24 RESISTORS from 10 ohms to 5.6 megohms
10 CAPACITORS from 100 mmfd to .5 mfd
2 ELECTROLYTICS, 10 mfd and 40 mfd
DEALER NET..... 12.75

Substitute for Electrolytic Capacitors

SENCORE ES102 ELECTRO-SUB

Usable from 2 to 450 volts, D.C.

Contains 10 electrolytics from 4 to 350 mfd. Select the correct value with the flick of a switch. Features automatic discharge, surge protector circuit. Prevents accidental "healing" of capacitor being bridged. Completely safe—no arc or spark when connecting or disconnecting. DEALER NET..... 15.95

Substitute for Fuse Resistors During Repair

SENCORE FS3 "FUSE-SAFE" CIRCUIT TESTER

Instantly tells you whether or not it is safe to replace fuse resistors, fuses, or circuit breakers. Separate red and green scale for each commercially available fuse resistor used in radio and TV. Eliminates guesswork and wasted time. Also handy for wattage checks up to 1100 watts. DEALER NET..... 8.95

Substitute for Bias Batteries During Repair

SENCORE BE3 "ALIGN-O-PAK"

Completely isolated DC supply, with less than 0.1% ripple. Eliminates messy batteries in TV service work. Handy for alignment, AGC trouble-shooting, or checking gated sync circuits. Just dial the voltage you need, 0-18 volts, positive or negative. Covers all voltages recommended by TV set manufacturers. Size, 3½x4½x1¾". For 110-120 volts, 60 cycle AC. DEALER NET..... 7.85

UNIVERSAL TV JUMPER CORD

Fits any set from back to chassis. Box has male and female plugs for additional power source, soldering, etc. DEALER NET 1.95

Turn page for other SENCORE® Time Savers

See your Parts Distributor Now!

SENCORE
ADDISON 2, ILLINOIS

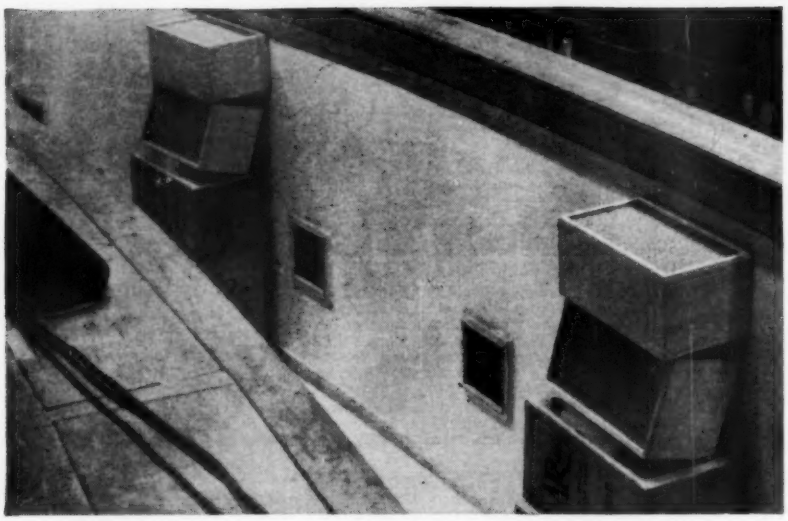
Microwave and Mobile Radio

Good future in Electronics for men without a degree . . .

Microwave communications and mobile radio are two fields developing at a rapid rate. Microwave's place in domestic as well as in international communications offers thousands of jobs for qualified non-degree men. Mobile radio, with its increasing use by police and fire departments, pipelines, railroads, telephone companies, truck lines, etc., offers even greater opportunities. You need fundamentals—and your FCC license.

Write for our free Career Information Material today or send the coupon on page 11.

CLEVELAND INSTITUTE OF ELECTRONICS DEPT. RE-34I
4900 EUCLID AVE., CLEVELAND 3, OHIO



orchestra pit in beersheba

When the Martha Graham dance group toured Israel, six AR-2 loudspeakers, with tape reproducing equipment, were taken along to provide musical accompaniment under circumstances where it was impractical to use live musicians.

Above are four AR-2's mounted in the orchestra pit of Cinema Karen in Beersheba (two more were placed backstage). These speakers were selected for the job because of their musical quality; the natural sound of the live instruments, rather than pseudo-hi-fi exaggerations, was desired.

AR *acoustic suspension* speaker systems—the AR-1, AR-2, and AR-3—are designed primarily for use in the home, but are also employed extensively by professional laboratories and studios. They are priced from $89 to $231.

Literature is available on request.

ACOUSTIC RESEARCH, INC. 24 Thorndike St. Cambridge 41, Mass.

Now you'll really know how to use OSCILLOSCOPES!

Get this complete guide to using the handiest instrument of all!

Men who know how to use 'scopes don't guess about trouble-shooting and tough re-alignment problems. They pinpoint troubles fast, adjust them quickly and accurately — and this famous 346-page manual teaches you the methods they use.

MODERN OSCILLOSCOPES gets right down to earth in showing you where and how to use these versatile instruments. Particular attention is paid to AM, FM and TV alignment procedures. Every detail is explained from connecting the 'scope and setting its controls to adjusting components in the chassis being tested. Illustrated instructions teach you to analyze patterns. Even includes data on quantitative measurements and use of 'scopes in lab work, industrial electronics, atomic work and teaching. 370 illustrations. Price $6.50.

PRACTICE 10 DAYS FREE

Dept. RE-109, RINEHART & CO., INC.
232 Madison Ave., New York 16, N. Y.

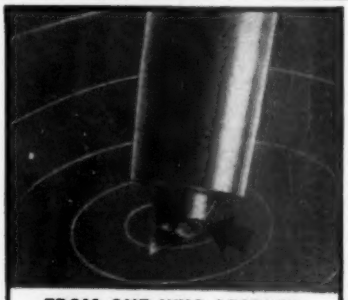
Send MODERN OSCILLOSCOPES for 10-day no risk examination. If I like book I will then send you $6.50 (plus postage) promptly in full payment. If not, I will return book postpaid and owe you nothing. **(SAVE! Send $6.50 with order and Rinehart pays postage. Same 10-day return privilege with money refunded promptly.)**

Name .....

Address .....

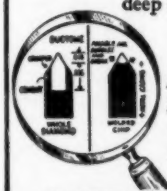
City, Zone, State.....

OUTSIDE U.S.A. - $7.00 cash only. 10-day money-back Guarantee.



FROM ONE WHO LEARNED

This enlargement shows a diamond-chip needle sent us by a disappointed user, who learned all diamond needles are not O.K. Shows what happens if a heat bubble forms when a chip is welded on. Can't happen with a Duotone Needle that uses only the *whole* diamond set deep in the metal shank.



Insist on Duotone. Be sure. Duotone's whole diamond can't break off.

DUOTONE DIAMOND NEEDLE

"that remembers"

Keyport, N. J.

In Canada: Chas. W. Pointon, Ltd., Toronto

BUSINESS and PEOPLE

Allan W. Greene was appointed president of Heath Co., Benton Harbor, Mich., according to an announcement by **Thomas Roy Jones**, president of the parent company, Daystrom, Inc. He comes to Heath from Motor-Mower, Inc., where he was general manager and a vice president of the parent company, Detroit Harvester Co.

Wayne Beaverson, chief engineer, was elected vice president in charge of engineering, Electro-Voice, Inc., Buchanan, Mich. He replaces **A. M. Wiggins**, who resigned recently.

John Messerschmitt (left) advanced to the position of manager, power tubes and renewal sales, of Amperex Elec-

tronic Corp., Hicksville, N. Y. **Irwin Rudich** was promoted to manager, special-purpose tubes and semiconductors.

Robert W. Carr, senior engineer in microphone development for Shure Bros., Evanston, Ill., was promoted to manager of the microphone development department.

Warren E. Dalbke (left) is now district manager, equipment sales, for CBS Electronics, working out of the

Chicago office. He was previously an equipment salesman. **Carl W. Dibling**, now Midwest field engineer, held the same position in the Eastern region.

Carl Schladen was named manager of the Manufacturing Div. of Orr Industries, Opelika, Ala. He joined the company late last year as chief industrial engineer and manager, technical section.

Bill Crawford was promoted to assistant sales manager of Oxford Components, Inc., Chicago. He has been with Oxford for a year and has a wide background in engineering and business administration.

Robert J. Cohen (left) joined Allied Radio, Chicago, as promotion assistant to **Leonard S. Preskill,** sales development manager. He had been with Traveler Radio. **Samuel S. Crandell** (right) joined Allied as customer services manager, from Ryerson Steel where he was office manager.

Edward C. Hughes, Jr. (left), administrator, commercial engineering programs for RCA Electron Tube Div., Harrison, N. J., advanced to the position of manager, commercial engineering. He succeeds **Robert S. Burnap** who retired recently, but continues with the company as a consultant.

RCA celebrates its 40th anniversary this year. The summer 1959 edition of the company house organ *Electronic Age* marked the celebration with special features and a chronology of the historic highlights in electronics during the past 40 years.

William G. Tuscany is now senior sales representative of the Erie Resistor Corp., Electronics Div., in the Midwestern regional sales district, Chicago.

Frederick R. Lack was elected to the board of directors of Dukane Corp., St. Charles, Ill. He recently retired as vice president of Western Electric Co. after 45 years with the Bell System.

Check TUBES, VIBRATORS THE SENCORE WAY

FAST ACCURATE TROUBLE SHOOTING

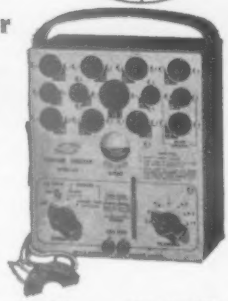
America's Most Popular Tube Tester

more than 25,000 now in use

SENCORE LC3 LEAKAGE CHECKER

Whips those "tough dog" tube troubles . . .

Ask any serviceman who owns one . . . or try one for just one day of servicing in your shop. You'll see for yourself how much time the LC3 can save *you*. Checks for leakage between all elements, whether caused by gas, grid emission or foreign particles. Also checks leakage on all capacitors with voltage applied—including electrolytics. Provides instant filament checks in "Fil-Check" position—no need for a second filament checker. One spare pre-heating socket and new roll chart prevent obsolescence. New charts provided—no charge. Leakage sensitivity, 100 megohms, control grid to all other elements; 50,000 ohms, heater to cathode. Size, 7x6x3½". Wt., 3 lbs. For 110-120 volts, 60 cycle AC. DEALER NET **28.95**



NOW . . . checks 172 tube types—more than any other checker of this type.

NEW . . . replaceable Roll Chart prevents obsolescence.

Check Filaments of All Receiving Tubes and Picture Tubes

FC4 FILAMENT CHECKER

For fast, easy checking of all tube filaments, without pulling chassis. Neon light goes out if tube filament is good. Also acts as continuity and voltage tester. Neon lamp glows when 115 v. AC is applied by cheater cord, providing a check on power to TV set. Size, 3½x4x1". With leads. DEALER NET..... **2.95**

Check 3- and 4-Prong Vibrators . . . Faster, Easier

VB2 "VIBRA-DAPTOR"

Plugs into any tube checker; ideal for use with LC3 above. To check 6-v. vibrators, set for 6AX4 or 6SN7; for 12-v. vibrators, set for 12AX4 or 12SN7. Two No. 51 lamps indicate whether vibrator needs replacing. Instructions on front panel. Steel case. Size, 1½x1½x3" DEALER NET..... **2.75**

See your Parts Distributor NOW!

Turn page for other SENCORE Time Savers

SENCORE

ADDISON 2, ILLINOIS

Guided Missiles

Good future in Electronics for men without a degree . . .

Outer space—one of mankind's greatest challenges. A field of work for men with imagination to spend their future in. Instrumentation, communications, navigation and control are the big problems on which you would work. More than half of every missile dollar is spent for electronics. You know that opportunity and salaries are good. You need the fundamentals. Then you can almost name your own terms.

Write for our free Career Information Material today or send the coupon on page 11.

CLEVELAND INSTITUTE OF ELECTRONICS DEPT. RE-343
4900 EUCLID AVE., CLEVELAND 3, OHIO

"IT TAKES TWO TO STEREO" *

...the perfect team for stereo!
For matchless reproducton of stereo recordings
— the Model 196 UNIPOISE Arm
with integrated Stanton Stereo FLUXVALVE pickup
and the GYROPOISE 800 airborne Stereotable.
Only the Stanton Stereo FLUXVALVE
has the exclusive "T-GUARD" stylus assembly
with the parallel reproducing element so important for stereo...
only the GYROPOISE Stereotable revolves on a bearing-of-air
— in magnetic suspension...
only the Stereo FLUXVALVE is warranted for a lifetime.
In plain truth, here is more to enjoy —
from both stereophonic and monophonic records.
Fine quality high fidelity products
by PICKERING & Co., Inc., Plainview, N. Y.

FOR THOSE WHO CAN HEAR THE DIFFERENCE Pickering

FLUXVALVE, GYROPOISE, STEREOTABLE, "T-GUARD", UNIPOISE

*Newly Revised—"It Takes Two to Stereo"—Address Dept. G-109 for Your Free Copy

Television
RADIO-ELECTRONICS
Electricity
ELECTRONICS
IN NEW SHOP-LABS OF COYNE

TRAIN QUICKLY! OLDEST, BEST EQUIPPED SCHOOL of ITS KIND in U.S.

Get practical training in New Shop-Labs of Coyne. Prepare for a better job and a successful future in a *top opportunity field*. Advanced education or previous experience not needed. Employment service to graduates.

Enroll NOW—Pay Later

Finance Plan and Easy Payment Plan. Also Part Time Employment help for students.

FREE BOOK Clip coupon or write to address below for Free Illustrated Book. "Guide to Careers"—Describes all training offered. No obligation and *No Salesman Will Call*. Act NOW.

B. W. Cooke, Jr., President
COYNE ELECTRICAL SCHOOL
CHARTERED NOT FOR PROFIT Established 1899
1501 W. Congress Pkwy. Chicago, Dept. 79-5C

COYNE Electrical School
1501 W Congress Pkwy., Chicago 7, Ill.
Dept. 79-5C

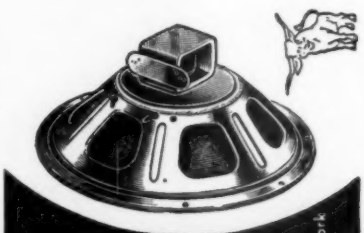
Send FREE book "Guide to Careers" and details of all training you offer. However, I am especially interested in:

☐ ELECTRICITY ☐ TELEVISION ☐ BOTH FIELDS

NAME.....

ADDRESS.....

CITY.....STATE.....



SPEAKERS for SOUND INSTALLATION

Regardless of your application . . . P.A., Inter-com, outdoor, extended-range . . . OXFORD is the SPEAKER for you. Our very complete line includes speakers that will meet your every need . . . quality . . . delivery. Write for our new catalog today.

Leading distributors carry OXFORD.

OXFORD COMPONENTS, INC.
556 West Monroe Street
Chicago 6, Illinois

OXFORD BRANDS: Supreme Transformers, Hudson Lamps, Tempo Hi-Fi, Oxford Speakers & Rear Deck Kits

Export: Roburn Agencies, New York
In Canada: Atlas Radio, Toronto

BUSINESS AND PEOPLE *(Continued)*

Edward O. Johnson was appointed manager, advanced development, RCA Semiconductor & Materials Div., Somerville, N. J. He had been manager, high-temperature product development. He succeeds **Dr. W. M. Webster** who is now administrative engineer on the staff of the vice president of RCA Laboratories.

I. Barbitta (left) was appointed production line manager, industrial communications, for the Gonset Div., Young Spring & Wire Corp., Burbank, Calif. He comes to the company from Link Radio, where he was vice president.

John Hunt joined Gonset as manager, amateur sales, from Collins Radio where he was assistant manager, amateur sales.

Harry R. Ashley, president of Electronic Instrument Co., Long Island City, N. Y., was among those presented with "American Success Story Awards" by the Free Enterprise Awards Association, Inc., for their "up from the ranks" achievements.

T. Edward Rogers, formerly with the Philco TechRep Div. in Washington, D. C., is now general sales manager of the Parts and Accessory Div. in Philadelphia.

EIA PRODUCTION AND SALES—first half

	1959	*1958*
TV set production	2,782,715	2,167,930
Total radio production	7,107,586	4,619,163
FM radio production	223,423	not available
TV retail sales	2,263,957	2,177,652
Radio retail sales	3,158,881*	2,712,134*
Receiving-tube factory sales	201,979,000	190,406,000
TV picture-tube factory sales	4,370,535	3,689,587

*Excluding auto radios.

Jensen Industries, Forest Park, Ill., designed a "cheese-tray" needle stock control case for distributors and dealers of its diamond or sapphire needles. The company also launched a Big 8 fall phono cartridge program, offering dealers a free stock cabinet with the purchase of a combination of eight of its most popular crystal cartridges.

Raytheon Co., Industrial Tube Div., achieved a record 4,000,000 accident-free man-hours, the longest run in its history, for which it was awarded a plaque by Liberty Mutual Insurance Co.

END

FAST AUTO RADIO SERVICE

As all service technicians know, the top and bottom of many auto radios are attached with ¼-inch hex-head self-tapping screws. Some auto radios have between 15 and 20 such screws and it's a slow, tedious job to remove them with a nut driver. I solved this problem by hacksawing the handle off a nut driver, and then inserting the nut driver shaft into a hand drill. Simply place the nut-driver shaft on a screw head, turn the crank and the screws pop out quicker than a wink. They can be replaced in the same manner if they are started by hand. This handy tool can also be used on TV high-voltage cages where many of these self-tapping screws are also used. —*Albert J. Krukowski*

GROMMET AIDS GUN LAMP REMOVAL

If the "spot light" of your soldering gun has ever blown, you know just how hard it is to remove it for replacement. It is difficult to get a good hold on the

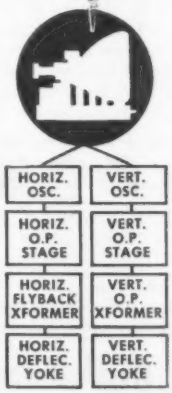
small, slick glass envelope to unscrew the bulb. However, the task is much easier if you take a small rubber wire feed-through grommet and press it tightly against the bulb's smooth envelope.—*Charles A. Cunningham*

RECEIVER CALIBRATION

A good receiver must be properly calibrated whether it is calibrated directly in frequency or a dial number. Dial calibration requires stable secondary standards plus some way of determining whether you are tuned to an even or odd harmonic. By itself, a 100-kc oscillator is not adequate for this purpose. The least expensive way to identify harmonics is to add a 200-kc crystal oscillator with a trimmer capacitor across the crystal. Once a zero-beat setting is established, turning

The missing link in TV service . . .

SENCORE SS105 SWEEP CIRCUIT TROUBLE SHOOTER



IT'S A . . .

UNIVERSAL HORIZONTAL OSCILLATOR. For direct substitution. No wires to disconnect in most cases. Traces trouble right down to the defective component. Variable output from 0-200 volts, peak-to-peak.

HORIZONTAL OUTPUT CATHODE CURRENT CHECKER. A proven method that quickly checks the condition of the horizontal output tube and associated components. Adaptor socket prevents breaking wires. Easily replaceable Roll Chart gives all necessary pin, current and voltage data.

UNIVERSAL DEFLECTION YOKE. A new, simple way to determine yoke failure accurately—without removing yoke from picture tube. Merely disconnect one yoke lead and substitute. If high voltage (also bright vertical line) is restored, TV yoke is defective.

DYNAMIC FLYBACK TRANSFORMER CHECKER. Merely flip switch to "Flyback Check" and meter will indicate condition of flyback transformer, in degrees of horizontal deflection. Extremely sensitive and accurate; even shows up one shorted turn on flyback.

VOLTMETER. For testing bootstrap, screen and other voltages. Direct-reading voltmeter, 0-1000 volts.

UNIVERSAL VERTICAL OSCILLATOR. Checks oscillator, output transformer and yoke. Merely touch lead to component and check picture on screen.

Size, 7x6x3½". Wt. 4 lbs.
For 110-120 volts, 60 cycle AC.

DEALER NET 39.50

See Your Parts Distributor NOW!

SENCORE
ADDISON 2, ILLINOIS

Radio & TV Broadcasting

Good future in Electronics for men without a degree . . .

More than ever before broadcasting is alive and growing. A few of the new industry problems requiring FCC licensed men are the greater use of directional antennas, growth of color television, and the developments of single sideband techniques. Such developments plus continued short supply of qualified men spell opportunity in capital letters. You need the fundamentals — and your FCC license.

Write for our free Career Information Material today or send the coupon on page 11.

CLEVELAND INSTITUTE OF ELECTRONICS DEPT. RE-344
4900 EUCLID AVE., CLEVELAND 3, OHIO

McGraw-Hill
BOOK NEWS

RADIO ENGINEERING HANDBOOK

Gives instant access to a wealth of essential engineering information in all major branches of radio, communications, broadcasting, aircraft radio, navigational aids, television, facsimile, and others. Offers concise data most needed by engineers, designers, and technicians — descriptions, charts, tables, and circuit diagrams. **Prepared by a Staff of Specialists. Keith Henney, Editor-in-Chief. 5th Ed. 1775 pp., over 1500 illus., $25.00** *(available on terms)*

BASIC ELECTRONICS

Just Out! Covers everything from basic electricity to tubes and transistors, giving you needed background for work in radio, communications, FM and TV radar, or industrial electronics. Packed with aids for self training. Explains clearly *ac* and *dc* circuits, magnetism, filters, resistance, batteries, tubes, r-f losses, and much more. **By Bernard Grob. 524 pp., 376 illus., $9.25**

TELEVISION SERVICING

A practical servicing manual giving you a "why-and-how" approach to TV repair . . . helps you handle more service calls and increase income and profits! Covers defects stage by stage, and shows how each fault appears on the screen. Prevents costly "blind-alley" checking . . . helps you spot defective stages and components fast. **By Alex Levy and Murray Frankel. 534 pp., 377 illus., $7.75**

TRANSISTORS in Radio, Television, and Electronics

2nd Edition—Just Out! Gives you a sound background and working knowledge of transistors and transistor circuits—how they are designed and how they work, and their use and maintenance. Shows how transistors are used in radio and TV sets, computers, counters, amplifiers, etc. **By Milton S. Kiver. 2nd Ed. 423 pp., 337 illus., $7.95**

ELECTRONIC COMMUNICATION

A basic how-to guide giving the essential electronics theory and practical information needed to pass all radio license examinations. The book covers the theory of electricity and electronics, as well as good operating techniques, in simple, understandable language. Includes helpful study questions taken from official FCC examinations. **By Robert L. Shrader. 936 pp. 771 illus., $13.00**

MAIL COUPON for

10 Days' FREE Examination

McGraw-Hill Book Co., Dept. RE-10
327 W. 41st St., New York 36, N.Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

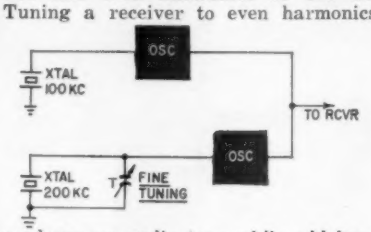
- ☐ Henney—Radio Engineering Hdbk.—$25.00 *(check here ☐ for terms: $5 in 10 days, then $5 monthly)*
- ☐ Grob—Basic Electronics—$9.25
- ☐ Levy & Frankel—Television Servicing—$7.75
- ☐ Kiver—Transistors—$7.95
- ☐ Shrader—Elec. Communication—$13.00

(PRINT)
Name
Address
City Zone State
Company
Position

For price and terms outside U.S. write McGraw-Hill Int'l., N.Y.C. 36 RE-10

TRY THIS ONE *(Continued)*

the trimmer slightly higher or lower lets the operator distinguish between odd and even harmonics of 100 kc. Tuning a receiver to even harmonics



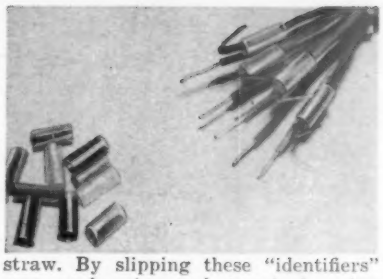
produces an audio tone while odd harmonics give off only an rf signal. Be careful not to overload the receiver, for too high an output fed into a nonlinear amplifier will produce unwanted beat frequencies.—*Albert J. Citrullo*

MAST MEASURES LEAD-IN

Ever wish for an easy way to measure the length of TV lead-in used for an antenna installation? It's pretty difficult to use a tape measure. Next time don't use a tape measure or estimate the amount of lead-in used—be sure, do it the easy way with a 5- or 10-foot section of mast. This way you won't overcharge or undercharge for the amount of wire used.—*Charles A. Cunningham*

WIRE-TERMINAL IDENTIFIERS

When I have to unsolder and remove a wire lead or a number of leads from a terminal in an electrical circuit, I mark the terminal and the wire with a short length of colored plastic soda



straw. By slipping these "identifiers" over each wire and terminal, using corresponding colors, I am always able to resolder the wires to their correct lugs. I keep a container full of the colored identifiers on my bench for instant use whenever they're needed.—*James C. Alexander* END

"Our serviceman is reactivating your tube right now."

LOOK

no further . . . if you're searching for hi-fi savings. Write us your requirements now.

Key Electronics Company
120-A Liberty St., N.Y. 6, N.Y.
EV 4-6071

BEST IN HI-FI VALUES!

NO DELAY SERVICE

All orders rushed to you in factory-sealed cartons.

Write for free catalog.

audion 25-E Oxford Road Massapequa, New York

How to make more money with your OSCILLOSCOPE

Noted electronics authority Albert C. W. Saunders tells you how in his fascinating new book **WORKING WITH THE OSCILLOSCOPE.** 26 illustrated projects, 200 diagrams, show you exactly how to use "electronics' most useful instrument" in electronics, radio, TV, transistors, vacuum tubes, other work.

The author, director of a famous electronics school, has worked with oscilloscopes 40 years. In clear, simple language he tells you how the 'scope works, the many jobs it will do, how to use it to make extra money, just as if he were sitting with you at your bench.

Send for your copy of

WORKING WITH THE OSCILLOSCOPE

today at the special limited-time price of only $4 postpaid. Satisfaction guaranteed or money refunded.

CUT OUT AND MAIL TO

Electronic Technical Publishing Co.,
Dept. RE, P.O. Box 306, Astor Sta., Boston, Mass.

Please rush A. C. W. Saunders' "Working with the Oscilloscope" to me. I enclose $..... for ..... copies at $4 each.

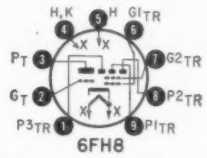
Name
Street
City & Zone State

NEW TUBES and SEMI-CONDUCTORS

HARMONIC generators, Citizens band transceivers, and TV damping are only some of the jobs to which this month's releases can be applied.

6FH8

A multi-unit 9-pin miniature tube containing a medium-mu triode and a sharp-cutoff tetrode with a pair of additional plates. The tube is intended



6FH8

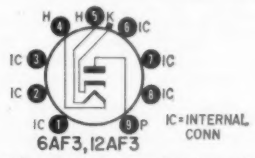
for use in harmonic generator applications.

Design maximum ratings for the RCA 6FH8 in harmonic generator service are:

		triode	tetrode
V_P		275	—
V_{P1}		—	275
V_{P2}		—	200
V_{P3}		—	200
V_{G2}	supply	—	275
V_{G1}	(neg bias)	40	40
	(pos bias)	0	0
P_P	(watts)	1.7	—
P_{P1}	(watts)	—	2.3
P_{P2}	(watts)	—	0.3
P_{P3}	(watts)	—	0.3

6AF3, 12AF3

Indirectly heated half-wave rectifiers designed for use as the damping diode in TV receiver direct-drive sweep circuits. They can withstand extremely high voltage pulses between cathode and both heater and plate. The cathode is connected to the top cap. The 6AF3



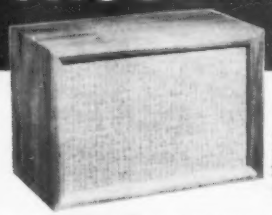
6AF3, 12AF3

has a 6.3-volt 1.2-amp heater while the 12AF3 has a 600-ma 12.6-volt controlled warmup heater for use in series-string circuits. All other ratings of these Sylvania tubes are identical.

Design maximum ratings of the 6AF3 and 12AF3 are:

V_P	(peak inverse)	4,500
I_P	(dc) (ma)	185

$11.90 Buys You an Acoustic-Designed 12" Bookshelf Enclosure Kit


14" H
21" W
11¾" D
20 lbs.

For those of you who need an added enclosure for stereo, or an extension speaker system, or just a space-saver that gives you good sound reproduction—at the lowest price available anywhere — you can't miss with this Model One enclosure kit from Homewood Industries. Here's a company that's been building furniture kits for years and knows how to build value into a kit—and still make it easy to do. Here's what **$11.90** buys—

- A bass-reflex baffle that takes a 12" speaker or an 8" speaker.
- A ¾" plywood enclosure with a four-sided natural veneer finish for horizontal or vertical use.
- A custom-furniture corner design that leaves no end-plys visible.

Price: 11.90 in birch
15.90 in walnut

If the need is for something bigger try the Model Two. Its 4½ feet of baffle area gives you quality reproduction in combination with a 12" speaker. Brass-ferruled legs give it a clean, modern appearance. Meets the highest Homewood standards.

29" H (with legs), 20" W, 12½" D. 25 lbs.
Price: 17.95 in birch

All you need to build is a Hammer-Screwdriver—and 30 minutes! That's how easy it is with a Homewood design.

Satisfaction Guaranteed or your money back in ten days. Send check or money order (no COD's). Freight collect.

HOMEWOOD INDUSTRIES Inc.
26 Court Street, Brooklyn 1, N. Y.
Please send me:
☐ Model One Bookshelf Enclosure
(Birch ☐ Walnut ☐)
☐ Model Two Enclosure ☐ Homewood Catalog
My check ☐ or money-order ☐
for_____ is enclosed.
Name_____
Address_____
City_____ Zone_____ State_____

NOVEMBER ISSUE ON SALE OCTOBER 27th

AT ALL BETTER PARTS DISTRIBUTORS AND NEWSSTANDS

We specialize in **ORIGINAL REPLACEMENT-PARTS** *for any* **EUROPEAN-MADE RADIO or PHONOGRAPH**
Complete Line of Parts for:
GRUNDIG — TELEFUNKEN
BLAUPUNKT — AKKORD
TONFUNK — NORDMENDE
SABA — LOEWE-OPTA
EMUD — METZ
For prompt service indicate make, model # or send defective part when ordering.
FOREIGN-COMPONENTS CO.
81-07 Broadway, Elmhurst 73, N.Y.
MAIL ORDERS ONLY

TV PICTURE TUBES
At Lowest Prices

10BP4	$ 7.95	17BP4	$ 9.95	21AMP4	$15.75
12LP4	8.50	17CP4	17.00	21ATP4	15.75
14B/CP4	9.95	17GP4	17.60	21AUP4	15.75
16DP4	12.00	17HP4	12.50	21EP4	13.50
16EP4	12.75	17LP4	11.50	21FP4	14.50
16GP4	14.50	17QP4	9.95	21WP4	14.00
16KP4	9.95	17TP4	17.00	21YP4	14.50
16LP4	10.95	19AP4	16.00	21ZP4	13.50
16RP4	9.95	20CP4	13.50	24CP4	23.50
16WP4	12.00	20HP4	14.50	24DP4	24.50
16PT4	9.95	21AP4	22.10	27EP4	39.95
17AVP4	12.50	21ALP4	15.75	27RP4	39.95

1 year warranty
Aluminized Tubes $5.00 more than above prices. Prices include the return of an acceptable similar tube under vacuum. These tubes are manufactured from reprocessed used glass bulbs. All parts and materials including the electron gun are brand new.
ALL PRICES FOR CHICAGO, ILLINOIS. Deposit required, when old tube is not returned, refundable at time of return. 25% deposit required on COD shipments. Old tubes must be returned prepaid. Tubes shipped Rail Express.
WRITE FOR COMPLETE LIST.
—PICTURE TUBE OUTLET—
3032 Milwaukee Ave., Chicago 18, Ill.
Dickens 2-2048

RECORD STEREO
using 2 monaural recorders
free literature
HARTLEY MFG.
Bellevue, Washington

Aeronautical Electronics
Good future in Electronics for men without a degree . . .
Control zone radar, navigational systems, electronic landing devices, engine accessories, ground communication facilities — all these are a part of one of the brightest electronic fields of all — aeronautical electronics. Airline men, for the most part, need an FCC license. They must meet rigorous training and experience requirements. First you need the fundamentals. Then opportunity's door opens for you.

Write for our free Career Information Material today or send the coupon on page 11.
CLEVELAND INSTITUTE OF ELECTRONICS DEPT. RE-345
4900 EUCLID AVE., CLEVELAND 3, OHIO

Introducing . . . "Jewels in Tools"

VACO® NUT DRIVERS

SP 500 $3.95 NET

- 5 beautiful nut drivers nested in attractive 2-tone plastic box with hinged cover
- Each driver identified for size by color of handle
- Highly polished chrome shafts (drilled 1½" deep) for good looks, long life
- Extra hard, machined sockets that "won't-round-out"

Special Offer!
Voltage Checker and Probe INCLUDED with purchase of two New Design VACO Nut Drivers. This is a $2.50 value for only $1.79 net. Instructions for using Voltage Checker included. A real "buy"!
SP 3 ONLY—$1.79

See Your Parts Jobber, Today!

VACO PRODUCTS COMPANY, 317 East Ontario St., Chicago 11, Illinois
In Canada: ATLAS RADIO CORP., Toronto 19, Ontario

FREE! CATALOG OF HI-FI, RADIO, TV PARTS & ACCESSORIES — yours for the asking!
Vidaire ELECTRONICS MFG. CORP. 44 CHURCH ST. • BALDWIN, N. Y.

Now! Hear Records at their Best!
Time Tested STAT-SIL Static-Silencer inhibits dust and static noise
Get rid of "pops" and "crackles" that interfere with ideal sound reproduction—spoil your listening pleasure. Use STAT-SIL that inhibits airborne dust attracted to the record by electro-static charges keeps records cleaner, longer. Easy to apply. Money back guarantee. Complete STAT-SIL kit only $1.50 postpaid.
GENEX CORP., DEPT. R, G.P.O. BOX 1124, NEW YORK 1, N.Y.

AT ELECTRONIC PARTS JOBBERS

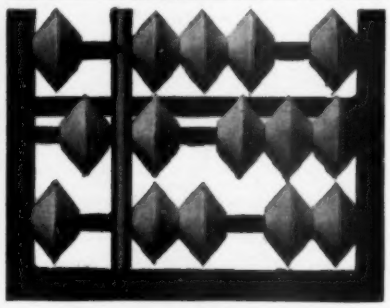
More D C Power at Less Hum
SERVICE
TRANSISTOR PORTABLES and 6/12 v. AUTO RADIOS

Does more at less cost . . . Handles more servicing jobs. Operates experimental transistor circuits, model railroads, relays. For laboratory work, electroplating, charging batteries, etc.

2 output ranges: 0-16 v. 5 amps. 0.5% maximum ripple; 0-20 v. 75 ma. 0.15% ripple • Separate meters for each output • Patented conduction cooling • Simple instructions.

Compare and you'll buy Model KPS-2 $43.50
Also—factory wired Model PS-2 . . . $49.95

Send for FREE literature, name of your jobber!
Electro Products Laboratories
4501-V Ravenswood, Chicago 40, Ill.
Name
Address
City Zone State



IT ALL ADDS UP WITH SPEAKERS BY wigo
PRONOUNCE IT WEEGO

Engineering integrity placed ahead of mere appearance, *plus* . . .

Prices related to actual costs, and not to "what the traffic will bear", *plus* . . .

Reliance on your ability to judge real quality and value. For literature, write . . .

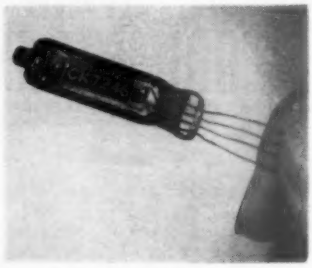
united audio
PRODUCTS OF DISTINCTION
202-4 East 19th St., N.Y.3, N.Y.

NEW TUBES & SEMICONDUCTORS *(Cont'd)*

I_p (steady-state peak) (ma)	750
P_p (watts)	6

CK7246

A filamentary subminiature triode operating up to 500 mc that is designed for use in portable communications equipment as a superregenerative detector, high-frequency oscillator, class-C amplifier, frequency multiplier or



mixer. The frequency range of the Raytheon CK7246 makes it particularly useful for transceiver use in the 465-mc citizen's radio band.

Typical operating characteristics are:

Class-A Amplifier

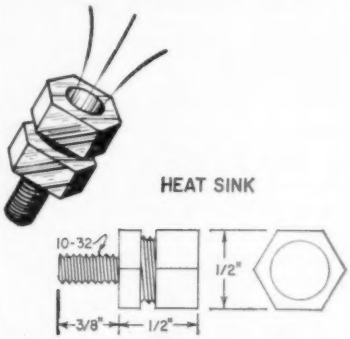
V_{fil}	1.25
I_{fil} (ma)	150
V_p	105
I_p (ma)	4.5
V_c	−2.5
Gm (μmhos)	2,700
μ	22

Class-C Oscillator (465 mc)

V_p	105
I_p (ma)	6
I_c (ma)	0.9
P_{output} (mw)	60

Transistor heat sink

A stud-mounted heat-sink mounting designed for transistors in the TO-5, TO-9 and TO-11 outline packages is being manufactured by Jadaro Machine Products. Its design provides a simple method of heat-sinking transistors that

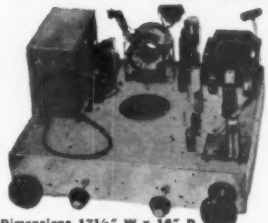


have a round weld package. Firmly tightening the gland nut provides a good thermal contact between the transistor and the heat sink. Heat generated in the transistor is conducted to the chassis through the threaded stud.

An insulated version provides complete electrical insulation between the transistor and the chassis. This is done by using a special type of hard-coat anodize finish on the heat sink. It pro-

DX-16 Super Deluxe TV KIT

70° or 90° — operating all 17", 21", 24" and 27" PICTURE TUBES



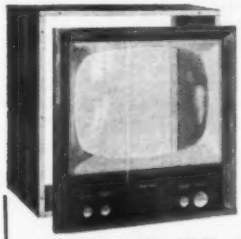
Dimensions 17½" W x 16" D
Shipping weight 40 lbs.

★ Produces a 16-Tube Chassis with 30-Tube performance.
★ Latest Intercarrier Circuitry and Multi-section Tubes.
★ Standard Neutrode Tuner for Selectivity & Fine Definition.
★ All Video and I.F. Coils factory pre-aligned and tuned.
★ Large 250ma Power Transformer for dependable service.
★ 12" Speaker or Twin-cone 6" x 9" Speaker.

Includes **LIFE-SIZE** step-by-step Building Instructions
Most Up-To-Date and Practical Course in Television

COMPLETE KIT
with SET of WESTINGHOUSE TUBES
4—6CB6, 6U8, 6T8, 6C4, 12BH7, 6SN7, 6BQ6, 6W4, 6K6, 1X2B, 5U4, 6BN4, 6CG8, incl. in the Tuner (less CRT) **$79.97**

Also sold on **EASY-PAYMENT-PLAN** Buy LIFE-SIZE Instructions—**$2.49**—and buy Parts as you build.



BUILD YOUR OWN CABINET FOR ANY TV CHASSIS

Comparable to the type that Top Mfrs. use on high priced TV sets.

CABINET KIT with 90% of the job done, includes—
FRONT SECTION in Solid Mahogany, Walnut or Blond Korina. **TOP, SIDES, BACK, MASK, SAFETY GLASS, ETC.**
And EASY-TO-FOLLOW ASSEMBLY INSTRUCTIONS

Front, Top and Sides supplied in a beautiful Piano Finish ● Knob panel undrilled ● For matching Mask specify type or number of CRT used. Same price—Mahogany, Walnut or Blond. (Shipping weight 36 lbs.)

21" CABINET KIT 26"H, 25"W, 22"D $26.97

17" TV Cabinet Kit . . $24.97 | 24" or 27" TV Cabinet Kit . . $38.47 | 24" or 27" Front Panel Assembly . . $24.97

HIT PARADE of "BEST SELLERS" at Slashed Prices!

VM CHANGER 4-speed incl. Stereo Cartridge . . . $26.94
RC-121 STEREO GARRARD CHANGER 4-speed 29.97
RC-88 STEREO GARRARD CHANGE 4-speed . . 44.62
RC-98 STEREO GARRDARD CHANGER 4-spee 53.24
G.E. STEREO DIAMOND CARTRIDGE #VR225 14.75
RONETTE or SONOTONE STEREO CART... 4.62
RECORD CHANGER BASE. any type, any finish 3.41
RECORD CHANGER BOARD any type, unfinished 1.49
$99 NORELCO 12" HI-FI SPEAKER #9762M 35.97
$16 NORELCO 8" HI-FI SPEAKER... #9770M 6.94
12" UNIVERSAL TWIN-CONE SPKR. 6.8 magnet 5.97
6" x 9" OVAL TWIN-CONE SPKR. 1.47 magnet 2.19
PHONO MOTOR 4-speed complete with T.T. etc. 4.61
PHONO ARM . . complete with 4-speed Cartridge 3.38
TWO-STATION INTERCOM. complete with tubes 15.38

110° TV CONVERSION KIT all Essential Parts $17.42
90° TV CONVERSION KIT all Essential Parts. . 15.98
70° TV CONVERSION KIT all Essential Parts. . 13.97
AGC KIT complete w/6AU6 and instructions . . . 4.59
UNIVERSAL 70° FLYBACK TRANSFORMER 4.86
UNIVERSAL 90° FLYBACK TRANSFORMER 5.24
UNIVERSAL 110° FLYBACK TRANSFORMER 5.74
17" TV MASK gray 13¾" x 17¼" 1.49
21" TV MASK gray 18" x 22½" 2.38
21" TV SAFETY GLASS 18" x 22½" 5.16
24" or 27" TV MASK gray 21" x 26" 4.93
24" or 27" TV SAFETY GLASS 21" x 26" 5.87
AC-DC PHONO AMPLIFIER incl 12AT6, 50B5, 35W4 5.98
$25 AC AMPLIFIER . . . . incl 3 Tubes, 5 watts 12.95
$27 4-SPEED PORTABLE PHONO. complete . . 13.78

Literature on CONVERSION & AGC KITS—Free on request. Stereo Changers and Cartridges we supply, play all records.

TUBULAR CONDENSERS—85°C TOP QUALITY—Equally as good for Radio or TV work

.0047-400v, .01-400v, .02-400v, .047-400v, .001-600v, .0047-600v, .01-600v, .02-600v, .03-600v 5¢ ea.
.1-400v, .25-400v, .47-400v, .047-600v, .1-600v, .25-600v, .001-1000v, .0047-1000v, .01-1000v .8¢ ea.
.035-1000v, .047-1000v, .1-1000v, .007-1600v, .03-1600v, .05-1600v, .005-3000v, .001-6000v, 14¢ ea.

ELECTROLYTIC CONDENSERS—85°C 1-50v, 1-150v, 2-450v, 5-150v, 10-150v 19¢ ea.

20/20-150v, 50/30-150v, 40-150v, 10-450v, 20-450v, 30-450v, 40-450v, 60-450v, 80-450v . . . . . 34¢ ea.

CARBON RESISTORS—Regular factory stock in Stackpole, I.R.C., Speer, etc.

½ WATT 10% 10, 39, 47, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820, 1k, 1800Ω . . . . 2¢ ea.
½ WATT 10% 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k, 27k, 33kΩ . . . . 2¢ ea.
½ WATT 10% 39k, 47k, 50k, 56k, 68k, 82k, 100k, 120k, 150k, 180k, 220k, 270k, 330kΩ . . . . 2¢ ea.
½ WATT 10% 390k, 470k, 560k, 680k, 820k,Ω 1, 1.2, 1.5, 2.2, 6.8, 10, 15 MEGΩ . . . . . 2¢ ea.
1 WATT 10% 3.3, 10, 39, 100, 120, 150, 330, 470, 560, 680, 820, 1k, 1800, 2700, 4700Ω . . 3¢ ea.
1 WATT 10% 6800, 10k, 15k, 18k, 22k, 27k, 33k, 39k, 47k, 68k, 82k, 100k, 150k, 470k, 680kΩ 3¢ ea.
2 WATT 10% 18, 22, 82, 100, 180, 2200, 3900, 4700, 6800, 8200, 18k, 22k, 100k, 470kΩ . . . . 4¢ ea.

WIREWOUND RESISTORS 5-5w, 16-10w, 20-10w, 47-5w, 100-5w, 140-5w, 220-5w. 16¢ ea.

280-10w, 390-5w, 470-5w, 500-10w, 680-10w, 820-5w, 1K-5w, 1K-10w, 1500-5w, 2K-10w . . . . 16¢ ea.
2500-5w, 3K-10w, 4700-5w, 5K-10w, 6K-10w, 7K-10w, 8200-5w, 10K-5w, 15K-5w, 22.5K-12w . . . 16¢ ea.

CERAMIC CONDENSERS 1, 2, 3, 5, 6, 10, 22, 25, 47, 50, 51, 56, 82, 100, 120, 150 mmf . . . . 3¢ ea.
CERAMIC CONDENSERS 220, 250, 270, 330, 470, 1k, 1200, 1500, 2k, 5k, 6800, 10k mmf . . . . 3¢ ea.
MICA CONDENSERS 5, 25, 50, 60, 68, 75, 100, 120, 150, 220, 270, 330, 470, 510 mmf . . . . 3¢ ea.
MICA CONDENSERS 560, 680, 820, 1k, 1500, 2k, 2500, 3300, 4700, 6k, 6800, 8k, 10k mmf . . 3¢ ea.

More "DOLLAR Buys"—Deduct 10% ON ORDER OF $10 OR OVER ON $1 BUYS

☐ 1 – 5" PM SPEAKER alnico #5 magnet $1
☐ 1 – 4" PM SPEAKER alnico #5 magnet. $1
☐ 1 – 3" PM SPEAKER alnico #5 magnet $1
☐ 1 – 2½" TWEETER SPEAKER for HI-FI $1
☐ 6 – SOCKET WRENCHES (Set) 3/16" to 7/16" . $1
☐ 3 – TV ALIGNMENT TOOLS assortment #1 . . . $1
☐ 3 – TV ALIGNMENT TOOLS assortment #2 . . . $1
☐ 3 – TV ALIGNMENT TOOLS assortment #3 . . . $1
☐ 3 – TV ALIGNMENT TOOLS assortment #4 . . . $1
☐ 3 – TV ALIGNMENT TOOLS assortment #5 . . . $1
EACH ALIGNMENT TOOL is different and valued at over $1.

☐ 3 – KENRAD TUBES #1LD5 . . . . . $1
☐ 4 – RCA TUBES # 1U4 also serves as a 1T4 . $1
☐ 3 – KENRAD #6C4 . . . . . $1
☐ 2 – GENERAL ELECTRIC TUBES #12SK7 . . . $1
☐ 2 – GENERAL ELECTRIC TUBES #25C5 . . . . $1
☐ 2 – KENRAD TUBES #6SH7 . . . . . $1
☐ 2 – RCA TUBES #12AL5 . . . . . $1
☐ 4 – KENRAD TUBES #1LE3 . . . . . $1
☐ 4 – RCA TUBES #12SR7 . . . . . $1
☐ 3 – RAYTHEON TUBES # 3Q4 . . . . . $1

"ONE DOLLAR" Buys

As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

DEDUCT 10% ON ANY ORDER OF $10 OR OVER
(ON DOLLAR BUYS)

Plus a FREE SURPRISE PACKAGE

☐ 100 – ASST. ½ WATT RESISTORS some 5% . . $1
☐ 70 – ASSORTED 1 WATT RESISTORS some 5% . $1
☐ 35 – ASSORTED 2 WATT RESISTORS some 5% . $1
☐ 1 – RCA 70° FLYBACK TRANS. #75240 . . . . $1
☐ 1 – $11 TODD 60° DEFLECTION YOKE $1
☐ 40 – ASST. PRECISION RESISTORS best sizes . $1
☐ 35 – ASST. DISC CERAMICS best numbers . . . $1
☐ 20 – TUBULAR CONDENSERS .05-600v $1
☐ 10 – TUBULAR CONDENSERS .47-600v. $1
☐ 50 – ASSORTED FUSES popular sizes $1
☐ 50 – ASST. TUBULAR CONDENSERS. $1
☐ 10 – 6' ELECTRIC LINE CORDS with plugs . . . $1
☐ 5 – TV CHEATER CORDS with both plugs $1
☐ 4 – 50' SPOOLS HOOK-UP WIRE 4 colors $1
☐ 50 – STRIPS ASST. SPAGHETTI best sizes . . . $1
☐ 100 – ASST. RUBBER GROMMETS best sizes . . $1
☐ 100' – TWIN LEAD-IN WIRE 300Ω heavy duty . $1
☐ 50' – FLAT 4-CONDUCT. WIRE many purposes . $1
☐ 25' – INSULATED SHIELDED WIRE. $1
☐ 32' – TEST PROD WIRE deluxe (red or black) . . $1
☐ 1 – $7 INDOOR TV ANTENNA hi-gain 3 section . $1
☐ 20 – ASST. TV KNOBS, ESCUTCHEONS, Etc. $1
☐ 3 – ASST. TOGGLE SWITCHES spst, dpdt, etc. . $1
☐ 6 – ASST. SLIDE SWITCHES spst, dpdt, etc. . . $1
☐ 4 – BAKELITE KNIFE SWITCHES dpdt $1
☐ 100' – FINEST NYLON DIAL CORD best size . . $1
☐ 200 – SELF TAPPING SCREWS #8 x ½" $1
☐ 35 – ASST. RADIO KNOBS screw and push-on . . $1
☐ 100 – KNOB SPRINGS standard size ¾" x ½" . . $1
☐ 100 – ASSORTED KNOB SET-SCREWS. $1
☐ 25 – ASSORTED CLOCK RADIO KNOBS. $1
☐ 600 – ASST. H'DWARE screws, nuts, rivets, etc. . $1
☐ 35 – ASST. SOCKETS octal, noval and miniature $1
☐ 20 – ASSORTED TUBE SHIELDS best sizes . . . $1
☐ 50 – ASST. MICA CONDENSERS some in 5% . . $1
☐ 50 – ASST. CERAMIC CONDENSERS " $1
☐ 10 – ASST. VOLUME CONTROLS less switch . . $1
☐ 5 – ASST. VOLUME CONTROLS with switch . . $1
☐ 100 – VOLUME CONTROL HEX NUTS. $1
☐ 20 – ASST. PILOT LIGHTS popular types $1
☐ 10 – PILOT LIGHT SKTS. bayonet type, wired . . $1
☐ 50 – ASST. TERMINAL STRIPS 1, 2, 3, 4 lug . . $1
☐ 10 – ASST. RADIO ELECTRO. CONDENSERS. $1
☐ 5 – ASST. TV ELECTROLYTIC CONDENSERS. $1
☐ 25 – ASST. MICA TRIMMER CONDENSERS. . $1
☐ 2 – ELECTROLYTIC COND. 40/40—450v $1
☐ 30 – FP CONDENSER MOUNTING WAFERS. . $1
☐ 3 – ELECTROLYTIC CONDENSERS 80-450v . . $1
☐ 3 – ELECTROLYTIC COND. 50/30-150v. $1
☐ 10 – HV TUBULAR CONDENSERS .007-1600v . $1
☐ 10 – HV TUBULAR CONDENSERS .001-6000v . $1
☐ 10 – HV TUBULAR CONDENSERS .005-3000v . $1
☐ 35 – MICA COND. 20-5mmf & 15-25 mmf $1
☐ 35 – MICA COND. 20-50 mmf & 15-68 mmf $1
☐ 35 – MICA COND. 20-100 mmf & 15-270 mmf $1
☐ 35 – MICA COND. 20-470 mmf & 15-680 mmf $1
☐ 35 – MICA COND. 20-920 mmf & 15-1000 mmf . . . $1
☐ 35 – MICA COND. 20-2200 mmf & 15-2400 mmf . . . $1
☐ 35 – MICA COND. 20-3300 mmf & 15-4700 mmf. . . $1
☐ 35 – MICA COND. 20-6800 mmf & 15-10000 mmf . . $1
☐ 35 – CERAMIC COND. 20-5 mmf & 15-10 mmf . . . $1
☐ 35 – CERAMIC COND. 20-25 mmf & 15-47 mmf . . $1
☐ 35 – CERAMIC COND. 20-56 mmf & 15-82 mmf . . $1
☐ 35 – CERAMIC COND. 20-100 mmf & 15-150 mmf . $1
☐ 35 – CERAMIC COND. 20-270 mmf & 15-470 mmf . $1
☐ 35 – CERAMIC COND. 20-1000 mmf & 15-1500 mmf . $1
☐ 35 – CERAMIC COND. 20-2000 mmf & 15-5000 mmf . $1
☐ 50 – 100KΩ ½ WATT RESISTORS 5% $1
☐ 50 – 470KΩ ½ WATT RESISTORS 10% $1
☐ 10 – ASST. WIREW'ND RES. 5, 10, 20 watt . . . $1
☐ 3 – AUDIO OUTPUT TRANS. 50L6 type. $1
☐ 3 – AUDIO OUTPUT TRANS. 6K6 or 6V6 type. . $1
☐ 3 – I.F. COIL TRANSFORMERS 456 kc $1
☐ 3 – I.F. COIL TRANSFORMERS 10.7 mc. FM. . $1
☐ 4 – OVAL LOOP ANTENNAS ass't hi-gain types $1
☐ 3 – LOOPSTICK ANT. new ferrite adjustable . . . $1
☐ 12 – RADIO OSCILLATOR COILS 456 kc $1
☐ 3 – ½ MEG VOLUME CONTROLS with switch . $1
☐ 5 – 50K VOLUME CONTROLS less switch. . . . $1
☐ 10 – SURE GRIP ALLIGATOR CLIPS. $1
☐ 1 – GOLD GRILLE CLOTH 14" x 14" or 12" x 18" . $1
☐ 5 – SETS SPEAKER PLUGS wired. $1
☐ 10 – SETS PHONO PLUGS and PIN JACKS. . $1
☐ 2 – $2.50 SAPPHIRE NEEDLES 10,000 playings . $1
☐ 5 – DIODE CRYSTALS 2—IN21 2—IN22 1—IN64. $1
☐ 3 – DIODE CRYSTALS 1—IN60, 1—IN64, 1—IN69. $1
☐ 2 – SELENIUM RECTIFIERS 1—65ma & 1—150 ma $1
☐ 15 – ASST. TV COILS sync. peaking, width, etc. . $1
☐ 5 – TV CRT. SOCKETS with 18" leads $1
☐ 5 – HI-VOLT. ANODE LEADS with 18" leads . . $1
☐ 10 – TV CARTWHEEL CONDENSERS 10kv $1
☐ 1 – LB. SPOOL ROSIN CORE SOLDER 40/60 . . $1
☐ $15 – "JACKPOT" TELEVISION PARTS. $1

HANDY WAY TO ORDER—Simply tear out advertisement and pencil mark items wanted (X in square is sufficient); enclose with money order or check. You will receive a new copy of this ad for re-orders.
ON SMALL ORDERS—Include stamps for postage, excess will be refunded. Larger orders shipped express collect.
FREE—RESISTOR & CODE CHARTS with each Order.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

TELEPHONE COrtland 7-2359

BOGEN
the sound way to better p.a.

NEW MIXER-PREAMPLIFIER

Higher gain—outstanding sensitivity—excellent signal-to-noise ratio—high output at low distortion—extremely low hum level.

In the new MXM, Bogen engineers have surpassed the previously unmatched quality and reliability of their superb LOM preamplifier. Building skillfully on experience gained from thousands of units in the field, they have developed a professional mixer-preamplifier of outstanding performance. The MXM offers higher reliability, ease of operation...at a conservative price. It is ideal for a wide range of p.a., studio, and broadcast applications.

Five Channels. The MXM is self-powered, accommodates five microphones, or four microphones and a tuner or phonograph. Each channel is regulated by a separate gain control (a master gain control is also provided). Features: individual speech filters for each channel, output level meter, sockets for plug-in, low-impedance transformers, feedback-type, distortion-free tone controls, and new variable level markers which permit instant resetting of controls to previously determined levels.

BOGEN MXM MIXER-PREAMPLIFIER

in the handsome design which won the Milan Triennial Gold Medal Award

Overall dimensions: 16¼" x 13" x 5⅜". Shipping Weight: 21 lbs.

BOGEN...THE SOUND WAY. Bogen's engineering excellence, crystallized during 25 years of manufacturing high-fidelity components, specialized sound systems for schools, theatres, industrial plants and offices, is yours to supply in the new MXM. Write today for more information.

BOGEN-PRESTO CO., PARAMUS, N. J.
A Division of the Siegler Corporation

Please send me complete details and specifications on the new Bogen MXM Mixer-Preamplifier.

Name_____

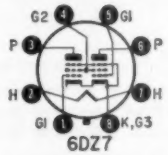
Address_____

City_____ Zone____ State_____

vides a 400-volt breakdown. The heat sinks typically increase transistor dissipation 3 to 4 times the free air rating or 85% of infinite heat-sink rating.

6DZ7

A twin power pentode designed for use in the output stage of hi-fi audio amplifiers. Its two pentode sections in one envelope make the 6DZ7 especially suitable for compact stereo systems.



6DZ7

Design maximum ratings of the General Electric 6DZ7—per section—are:

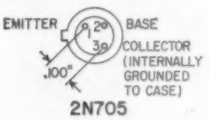
V_P	440
V_{G2}	300
P_P (watts)	13.2
P_{G2} (watts)	4

Characteristics in a push-pull Class-AB1 amplifier are:

	Fixed Bias	Cathode Bias
V_P	400	300
V_{G2}	250	250
V_{G1}	−11	———
$R_{cathode\ bias}$ (ohms)	———	120
$V_{peak\ at\ grid\ to\ grid}$	22	22
I_P (zero signal) (ma)	40	66
(max signal) (ma)	100	80
I_{G2} (zero signal) (ma)	4	7
(max signal) (ma)	13	15
R_L (plate to plate) (ohms)	9,000	9,000
Harmonic distortion (total %)	2.5	3.5
Max signal power out (watts)	18	12

2N705

A p-n-p germanium diffused-base mesa high-speed switching transistor.



2N705

It is made by the diffusion process for high-speed logic applications.

Maximum tentative ratings of the Texas Instruments 2N705 are:

Design characteristics at 25°C are:

V_{CB}	15
V_{EB}	3.5
I_E (ma)	50
I_C (ma)	50
P_{total} (mw)	300

Design characteristics at 25° C are:

h_{FE} (V_{CE} = 0.3, I_C = 10 ma) (typ)	40
h_{fe} (V_{CE} = 10, I_C = 10 ma, f = 100 mc) (db) (typical)	6
f_{ocb} (V_{CB} = 5, I_C = 10 ma) (mc) (typical)	300

Self-indicating thyratrons

Two cold-cathode units (7400 and subminiature 7401) and one hot-filament type (7323) make up a complete family of self-indicating thyratrons.

The cold-cathode units require no heater power and provide a bright

Please,..

mention
RADIO-ELECTRONICS
when answering advertisements

ADD TO YOUR INCOME
Learn at Home to Fix APPLIANCES

FREE SAMPLE LESSON

Tester Furnished—No Extra Charge. National Radio Institute trains you at home. Every service customer is worth more when you can fix his electrical appliances. Mail coupon for Lesson and Catalog.

National Radio Inst., Dept. FK9, Washington 16, D.C.
Please send me Electrical Appliance Sample Lesson and Catalog FREE (No salesman will call).

Name_____ Age____

Address_____

City_____ Zone____ State____

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

PURCHASING A HI-FI SYSTEM?

Send Us Your List Of Components For A Package Quotation

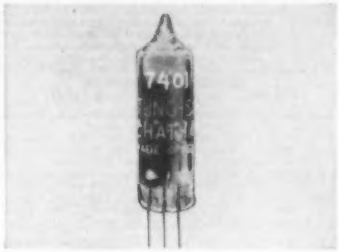
WE WON'T BE UNDERSOLD!

All merchandise is brand new, factory fresh & guaranteed.

AIREX RADIO CORPORATION
64-RE Cortlandt St., N.Y. 7, CO 7-2137

PARTIAL LIST OF BRANDS IN STOCK

Altec Lansing
Electrovoice
Jensen
Hartley
University
Acoustic Research
Janszen
Wharfedale
Karlson
Viking
Concertone
Bell • G.E.
Weathers
Harman-Kardon
Eico • Pilot
Sherwood
Acrosound
Fisher
Bogen • Leak
Dynakit
H. H. Scott
Ferrograph
Tanberg
Pentron
Ampro • VM
Revere
Challenger
Wollensak
Garrard
Miracord
Glaser-Steers
Rek-O-Kut
Components
Norelco
Fairchild
Pickering • Gray
Audio Tape
Conrac
Wellcor Cabinets

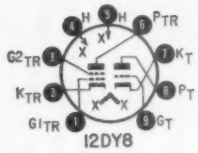


surface-glow indication for end-on viewing. A small pulse voltage, which can be generated by transistor equipment, is superimposed on a dc bias to trigger these tubes.

The 7323 needs 1/3 watt filament power and —4.5 volts dc grid bias. Trigger signals can be applied directly at ground reference level. The gas discharge glow is not as bright as that of the cold cathode versions but can be viewed end-on or from any side. All three units are made by the Chatham Division of Tung-Sol.

12DY8

A double-section tube featuring a tetrode designed for relay service in signal-seeker applications and a general-purpose sharp-cutoff triode. The tube is intended for operation where the heater, plate and screen voltages



12DY8

are obtained directly from a 12-volt automobile battery.

Made by Sylvania, characteristics and typical operating specifications of the 12DY8 are:

		triode	tetrode
V_P		12.6	12.6
V_{G1}		0 contact potential bias developed across specified grid resistor	
R_{G1}	(megohms)	———	2.2
V_{G2}		———	12.6
Gm	(μmhos)	2,000	6,000
μ		20	———
R_P	(ohms)	10,000	5,000

END

CORRECTION

Two typographical errors appeared in the captions for the Baldwin organ photographs in the article "Servicing Electronic Organs" in the August issue. The Baldwin 5A is referred to as an A5 (page 30) and the word "lower" used instead of "upper" on page 31. That caption should read "Master oscillators and power amplifiers are on the upper chassis."

A large number of correspondents called these errors to our attention.

(See also correspondence column).

Olson

FREE

Fill in coupon for a FREE One Year Subscription to OLSON RADIO'S Fantastic Bargain Packed Catalog — Unheard of LOW, LOW, WHOLESALE PRICES on Brand Name Speakers, Changers, Tubes, Tools, Hi-Fi's, Stereo Amps, Tuners and thousands of other Electronic Bargains.

NAME_____

ADDRESS_____

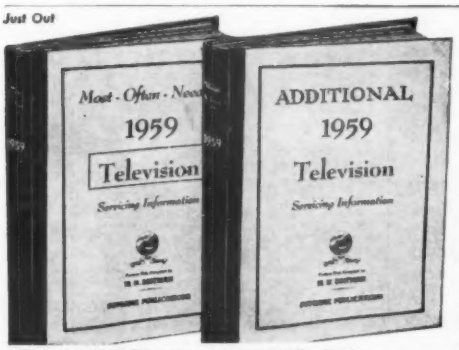
CITY_____ ZONE____ STATE_____

If you have a friend interested in electronics send his name and address for a FREE subscription also.

OLSON RADIO CORPORATION

700 S. Forge St., Akron 8, Ohio

Just Out



These *two* **1959 TV** volumes cover practically all sets of all makes. The new ADDITIONAL **1959 TV** manual includes material almost to the minute. Each giant manual has 192 pages of service data and repair hints, factory changes, double-size circuits. Special price, each only.. **$3**

New ADDITIONAL 1959 TV Volume

LARGE MANUAL COVERS NEWEST 1959 TV SETS
EARLIER TV VOLUMES STILL SOLD AT ONLY $3

AMAZING BARGAINS

Supreme twin **1959 TV** manuals are the scoop of the year. Cover all sets of all important makes. New ADDITIONAL **1959 TV** volume gives you the very latest material. Your price for this mammoth manual is only **$3.** *Supreme* super values defy competition. Each prior-year manual (at only $3) has a whole year of service material. Each volume covers different material, from 1948 to latest 1959 sets. Include circuits, waveforms, alignment, voltage charts, service hints, changes, and double-spread diagrams. Practically tell you how to make every repair. More pages, more diagrams, more service data per dollar of cost. To get the best for less, get *Supreme* manuals.

Supreme **TV** manuals supply all needed service material on every TV set of every important manufacturer. Here is helpful, practical, factory-prepared data. It will really make TV servicing and adjustment easy for you. Join 167,000 servicemen who use, benefit, and save with SUPREME service manuals. In these volumes you get correct factory-checked circuits, alignment procedure, printed boards views, service hints, recommended changes, wave-forms, voltages, easy-to-use giant-size diagrams.

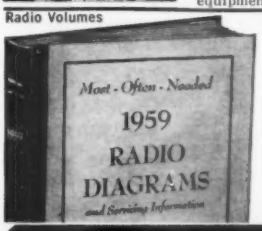
BEST AT LOWEST COST

Here is your TV service material to help you do expert work double-quick; and priced at only $3 per annual volume. Be ready to repair any model by carrying in your car all 14 TV volumes listed in coupon below. Or try one of the new **1959 TV** manuals to see what an amazing bargain you get for only **$3.** See *no-risk* coupon.

TELEVISION SERVICING COURSE

Let this new course help you in TV servicing. Amazing bargain, complete, only $3, full price for all lessons. Giant in size, mammoth in scope, topics just like a $200.00 correspondence course. Lessons on picture faults, circuits, adjustments, short-cuts, UHF, alignment facts, hints, antenna problems, trouble-shooting, test equipment, picture analysis. Special, only **$3**

Radio Volumes



RADIO DIAGRAMS

Supreme is your best source for all needed RADIO diagrams and service data. Covers everything from the most recent 1959 radios to pre-war old-timers; home radios, auto sets, combinations, changers, stereo, FM, and portables. Sensational values. Only $3 for many volumes. Every manual has extra large schematics, all needed alignment facts, printed boards, voltage values, trimmers, dial stringing, and helpful hints. Volumes are large in size 8½x11 inches, about 196 pages. See coupon at right for a complete list of these radio manuals. →

Supreme Publications

Sold by All Leading Parts Jobbers

NO-RISK TRIAL ORDER COUPON

SUPREME PUBLICATIONS, 1760 Balsam Rd., Highland Park, ILL.

Rush today TV manuals checked ☒ below and Radio manuals at left. Satisfaction guaranteed.

☐ 1959 ☐ 1958 ☐ 1957 ☐ 1956 — Popular RADIO Diagram Manuals at only $2.50 each....

☐ 1955 Radio Manual, only $2

☐ 1954 ☐ 1953 ☐ 1952 ☐ 1951 ☐ 1950 ☐ 1949 — These annual RADIO volumes specially priced at only $2.50 each....

☐ 1948 ☐ 1947 ☐ 1946 ☐ 1942 ☐ 1941 ☐ 1940 — THIS GROUP ONLY $2 EACH

☐ 1926-1936 Manual, $2.50

☐ Radio and TV Master Index, 25¢

☐ *New* **Additional 1959 Television** Manual, only **$3.**

☐ **Early 1959 Television** Manual, **$3.** ☐ **1958 TV, $3.**

☐ **Early 1957 TV, $3.** ☐ **Additional 1957 TV, $3.**

☐ **1956 TV** Manual, **$3.** ☐ **Additional 1955 TV, $3.**

☐ **Early 1955, $3.** ☐ **1954 TV, $3.** ☐ **1953 TV, $3.**

☐ **1952 TV, $3.** ☐ **1951 TV, $3.** ☐ **1949 TV, $3.**

☐ **1948 TV, $3.** ☐ **1957-58 RCA TV** Manual, **$1.50**

☐ *New* **Television Servicing Course,** complete....**$3.**

☐ I am enclosing $..... Send postpaid.

☐ Send C.O.D. I am enclosing $.....deposit.

Name: .....

Address: .....

LOW COST! TOP QUALITY!

BUILD YOUR OWN PORTABLE RADIOS

SAVE UP TO 52%

American Made!

VEST POCKET*

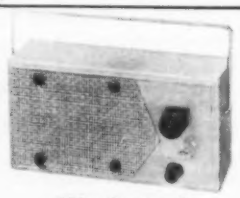
3 TRANSISTOR & DIODE RADIO KIT

Small in size . . . yet a real powerhouse! World famous LOOPSTICK assures maximum reception everywhere! Now you'll never miss your favorite programs. All parts included.

- No antenna or ground needed
- Gold-plated printed circuit board
- Hi "Q" flat loopstick
- Personal Hi-Fi earphone included
- Easy to build — illustrated instructions

MODEL VP
Radiophile
Net $11.95
(List $19.95)

*Winner of Dan-Mar award for futuristic styling.



"The Partner"

4 TRANSISTOR & DIODE RADIO KIT

Easy to build, even for a beginner! Take it with you anywhere . . . your real "Partner". Don't miss ball games, news, your favorite programs. Comes COMPLETE with all parts, and simple, illustrated instructions.

- Pre-punched, gold - plated printed circuit board
- Newest transistors & diode
- Exclusive Flat Transistor Loopstick for unsurpassed sensitivity and power
- Powerful 2½" loudspeaker
- Compact portable case 2-15/16" x 5¾" x 1½"
- Earphone jack
- Newest low battery consumption circuitry

MODEL
TR4-K
Grey & Gold
TR4-KB
Black & Gold
TR4-KM
Maroon & Gold
Radiophile
Net $17.95
(List $27.95)

FREE BONUS: Miniature Earphone for private listening.

"SEXTET"

6 TRANSISTOR & DIODE PORTABLE RADIO

MODEL
TR66 Grey and Gold
TR6B Black and Gold
TR6M Maroon and Gold
Radiophile Net $25.95
(List $39.95)

Professional engineering and award winning styling.

Friends and neighbors will wonder at its beauty and performance . . . and YOU built it yourself! Easy to build—if you can read and solder you've got it made. Superb reception . . . Hi-Fi tonal quality.

- Powerful superhet.
- 3 tuned I.F. stages
- Push-pull audio 300 M.W. max.
- Pre - punched gold-plated printed circuit board
- High-gain Flat loopstick
- Full action A.V.C.
- Jack for private listening
- Compact, unbreakable case
- Economical operation
- COMPLETE with all parts and illustrated instructions

EXTRA BONUS: Free earpiece for personal listening!

At your radio parts distributor or write direct for FREE CATALOG and name of local distributor

Superex 4-6 RADFORD PLACE, YONKERS, NEW YORK

LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

ELECTRONICS PARTS AND EQUIPMENT fill this 218-page *1959 Catalog* of industrial and amateur equipment, radio and TV supplies and electronic components. Amateur receivers and transmitters, antennas, tools and PA equipment are included.—**Modern Electronics Co.**, 2000 Broadway, San Antonio 6, Tex.

STEREO NEEDLE REPLACEMENT *Guide* is a 16-page manual showing pictures of most popular packaged stereo phonographs and consoles, cross-indexing their replacement styli. It also lists replacements for most popular cartridges in both sapphire and diamond versions, along with a cross-reference chart for replacement needles of other manufacture.—**Duotone Co., Inc.**, Keyport, N. J.

RADIO–TV INDUCTOR REPLACEMENTS may be made using the 36-page *Parts Selector Catalog*. Exact replacements are featured with helpful service hints. —**Ram Electronics**, 600 Industrial Ave., Paramus, N. J.

REPLACEMENT AND IDENTIFICATION KEY is a 20-page book which allows ready selection of the correct phonograph stylus. It is used along with a large wall chart which will often be adequate for exact needle identification. —**Fidelitone, Inc.**, 6415 Ravenswood, Chicago 26, Ill.

PICTURE-TUBE COMPARISON CHART shows characteristics and base diagrams for about 300 cathode-ray picture tubes from 7DP4 to 30BP4. Suitable for wall hanging, it is printed on only one side.—**Sylvania Electric Products, Inc.**, 1740 Broadway, New York 19, N. Y.

1959 NEDA BATTERY INDEX is a cross-referenced chart of comparative and interchangeable batteries, showing the type numbers of 20 major battery makers. Two may be requested if desired for wall mounting.—**National Electronic Distributors Association, Inc.**, 343 S. Dearborn St., Chicago 4, Ill.

PREFERRED RECEIVING TUBES *for High Fidelity, FM–AM, TV and Industry* is

OPPORTUNITY ADLETS

Rates—50c per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for December issue must reach us before Oct. 15, 1959.

RADIO-ELECTRONICS,
154 West 14 St., New York 11, N. Y.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone: BARRY, 512 Broadway, New York 12, N.Y. WAlker 5-7000.

HI-FI, Recorders, Tapes. FREE Wholesale Catalogue. CARSTON, 125-T East 88th St., New York 28, N. Y.

STEREO TAPE RENTALS. For the very best at lowest prices. Write CALIFORNIA TAPED MUSIC ASSN., 763 El Camino Real, Redwood City, Calif.

DISCOUNTS UP TO 50% on Hi-Fi amplifiers, tuners, speakers, tape recorders, individual quotations only, no catalogs. CLASSIFIED HI-FI EXCHANGE, 2375 East 65th Street, Brooklyn 34, N.Y.

FOR THE ULTIMATE THRILL in stereo sounds, write for the Cat/Tape stereo tapes titled (St. Francis Whispers) Authentic sounds of San Francisco. What & Where) Party guessing game. Ghost Trains) Steam trains recorded all over historic Calif. Mustard & Sand) A day at Santa Cruz famous board walk. Omnibus) Cal/Tape demonstrator. Relaxation) Mood music played by Jose Guillen on the Hammond Organ at World Famous Rickeys Studio Inn, Palo Alto, Calif. All recording are 2 Channel 7½ ips. Prices are from $7.95 to $9.95. Distributor inquiries welcome. CALIFORNIA TAPED MUSIC ASSN., 763 El Camino Real, Redwood City, Calif.

LABORATORY QUALITY equipment and Military Surplus Electronics bought, sold. ENGINEERING ASSOCIATES, 434 Patterson Road, Dayton 9, Ohio.

FM TUNERS, 88-108 megacycles, 4 tubes complete, $14.95. GRUTMAN, 1 East 167 St., Bronx 52, N.Y.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. HAZELTON INSTRUMENT Co., 128 Liberty Street, New York, N.Y.

WHAT YOU KNOW plus spare time ought not be wasted.Let us show you how. Order your copy of Inventing The Invention today. $4.95 post paid. EATON ROLLER & MANUFACTURING COMPANY, 300 North Meridian, Eaton, Indiana.

DIAGRAMS FOR REPAIRING RADIOS $1. Television $2. Give make, Model. DIAGRAM SERVICE, Box 672-RE, Hartford 1, Conn.

SPECIAL OFFER, Complete correspondence course in Electronics, Television and Radio only $49.50. All new modern material. Formerly sold for $400. 43 texts over 2000 pages. Limited number available. Write dept. RE, ELECTRONICS TRAINING, P.O. Box 764, Pittsburgh 30, Pa.

CAMERA Repairmen greatly needed! You can learn manufacturers' service methods at home, in your spare time! Free, big illustrated book tells how! Write today. NATIONAL CAMERA REPAIR SCHOOL, Dept. RE-9, Englewood, Colorado.

OFFSET PRINTING—1,000 8½x11 $5.50. 5M/$17. Color or white. Fast! 5,000 colored circulars $39. Complete: Art, copy, layout, printing. PROMOTION—R10, 385 Broadway, New York 13, N. Y.

SONGPOEMS and LYRICS WANTED! Mail to: TIN PAN ALLEY, INC. 1650 Broadway, New York 19, N. Y.

LEARN WHILE ASLEEP, Hypnotize with your recorder, phonograph or amazing new Electronic Educator endless tape recorder. Catalog, details free. SLEEP-LEARNING ASSOCIATION, Box 24-RD, Olympia, Wash.

SCOTCH recording tape at Profit-Sharing prices. Send for Catalog—you'll be glad you did! TAPECO, Dept. K, PO Box 4353, Inglewood 3, Calif.

RENT STEREO TAPES. Over 800 different, all major labels. Free catalog. Stereo-Parti, 1608-K Centinela Ave., Inglewood 3, Calif.

WHOLESALE appliance parts catalog—25¢. Fully illustrated. Jam packed! SECO, 26 So. 20 St., Birmingham 3, Ala.

LEARN TELEVISION Servicing. Complete simplified course $3. SCIENTIFIC & TECHNICAL STUDIES, PO Box 4016, Brighton Sta., Rochester 10, N.Y.

ELECTRONIC ORGAN parts. Special transformers, coils, diagrams. R. PAVELKA CO., Box 5985, Cleveland 1, Ohio.

GROW MUSHROOMS. Cellar, shed and outdoors. Spare, full time. Year round. We pay $4.50 lb. dried. We have 20,000 customers. FREE book, MUSHROOMS, Dept. 349, 2954 Admiral Way, Seattle, Wash.

USED BOOKS. Courses. Bought and sold. HUTCHIN, 4167 Hemphill, Fort Worth, Tex.

US NAVY'S new excellent publications: BASIC ELECTRICITY, 684 pages, $2.25; BASIC ELECTRONICS, 728 pages, $2.25. Postpaid, no COD's. FOSTER'S, Box 703, Silver Spring, Md.

5-INCH TV Test CRT. Complete with adapter $3.95 post paid. CRYSTAL ELECTRONICS, 9507 101st Ave., Ozone Park, N.Y. HI 1-0700.

TAPE RECORDERS, recording tape, Bell tape decks, Hi-fi equipment, Norelco speakers. WE WILL NOT BE UNDERSOLD! Send for our discount catalog and see why! COMMISSIONED ELECTRONICS, 1776 Columbia Rd., Washington, D.C.

INDUCTORS for Crossover networks. 118 types in stock. Send for brochure. C & M COILS, 3016 Holmes Ave., N.W., Huntsville, Ala.

HI-FI DOCTOR—will solve your hi-fi problems on the spot. Acoustic, Audio, Radio Engineer. Stereo Designing. Professional visits, day evening, New York area. WILLIAM BOHN, Plaza 7-8569, weekdays.

BARGAIN parts kit M102—fabulous assortment. 20 lbs., 50 items, $50 value for $3, add postage. MDC 944 W. Tioga Street, Philadelphia 40, Pa.

a 4-page leaflet describing 35 Mullard high-performance tubes such as the ECC83 (12AX7) and the EL34 (6CA7), along with their American equivalents. Maximum values as well as typical operating conditions are supplied.—**International Electronics Corp.**, 81 Spring St., New York 12, N. Y.

TRANSISTOR VOLTAGE REGULATOR circuit is the subject of the latest issue of *Application Notes*, published irregularly. It shows two diagrams and discusses the circuit thoroughly, giving results of experimental models.—**Texas Instruments Inc.**, Box 312, Dallas, Tex.

PARTS AND ACCESSORIES for Admiral radio and TV sets, phono record changers, bases and mike stands are all listed in the 72-page *1960 Catalog*. In addition to parts for Admiral sets, there is a 20-page section of cross-referenced information on universal replacement parts.—**Admiral Corp.**, 3800 Cortland St., Chicago 47, Ill.

INDUSTRIAL AND AMATEUR parts catalog has 274 pages showing intercoms, connectors, small parts and extensive listings of communications gear. —**Harrison Radio Corp.**, 225 Greenwich St., New York 7, N. Y.

AUTO RADIO COIL GUIDE *Catalog 260* is a 20-page booklet listing every auto radio coil in use by radio make. It includes a cross-reference of 1,000 part numbers from 45 manufacturers.—**J. W. Miller Co.**, 5917 S. Main St., Los Angeles 3, Calif.

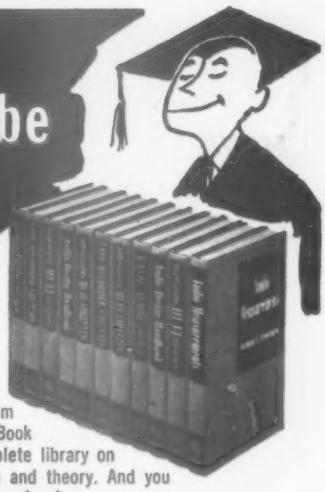
CONTROLS, SWITCHES, CAPACITORS are listed in a 24-page *Electronic Components Catalog*. Over 1,700 items are included, among which are the company's packaged electronic circuits, ceramic capacitors and exact replacement controls.—**Centralab, Div. of Globe-Union, Inc.**, 900 E. Keefe Ave., Milwaukee, Wis.

HOME TRAINING COURSE in radio–television–electronics is described in detail, along with a summary of the employment situation in various phases of electronics. The history of the school as well as photos and a description of its staff and teaching methods are included in this 32 page booklet. *Your Future in TV/Radio/Electronics*. Includes application blanks and GI benefit questionnaire. — **National Technical Schools**, 4000 So. Figueroa St., Los Angeles 37, Calif.

TV–FM HOME OUTLET installation and use is described in an issue of the *Technical Reporter* with detailed photographs and diagrams. Subscription to the entire series of *Technical Reporter* is also available on request.—**Jerrold Electronics Corp.**, 15th and Lehigh Ave., Philadelphia 32, Pa.

SPEAKERS, ENCLOSURES, COMPONENTS. Entire line of drivers, cabinets and parts for speaker systems is pictured and described in detail in 3-color 28-page *Catalog 134*. Prices of all units are included. — **Electro-Voice, Inc.**, Buchanan, Mich. END

NOW you can be an MHF!



Master of High Fidelity that is. If you're the least bit interested in improving an amplifier, getting better response, getting rid of hum—or even getting a system to look like it belongs in a living room—the G/L Hi-Fi Book club plan is for you. Through it you can get a complete library on just about every single phase of audio-hi-fi practice and theory. And you can build it gradually and painlessly and at discount prices!

Yes here's a whole set of beautifully printed and handsomely bound books that you can acquire—one at a time. Regularly they sell for $5.00—but club members may buy them at only $3.75 and there's no risk. You send no money. We send you each book on approval. You pay only if you keep the book. What facet of hi-fi do you want to learn more about—fundamentals? circuit design? amplifiers? tape recording? stereo? furniture design?—there's a G/L Hi-Fi book on all of them. Look over the list below. See how easy it is to join—then send in that coupon today.

JOIN NOW—Select any one of these books already published.

STEREO—HOW IT WORKS—By Herman Burstein. All about stereo—what it is. What it can do, what it can't do. Points out its limitations, warns about pitfalls as well as telling you the enjoyment stereo can bring. Covers everything—stereo on the air, on discs and on tapes—from fundamentals to installation and advanced techniques and applications.

DESIGNING AND BUILDING HI-FI FURNITURE—By Jeff Markell. How to have a hi-fi system that looks as good as it sounds. For the hi-fi fan—or home craftsman. Covers everything from what woods and tools to use to finishing, retouching, repair—and room arrangement.

AUDIO MEASUREMENTS—By Norman H. Crowhurst. Covers audio measurements from service shop to laboratory level. Shows how to make tests, what instruments to use, how to interpret results.

H. A. HARTLEY'S AUDIO DESIGN HANDBOOK—This expert explains design principles so the non-engineering hi-fi fan can design his own equipment.

ELEMENTS OF TAPE RECORDER CIRCUITS—By Herman Burstein and Henry C. Pollak. Answers all your questions about the electronic aspects of a tape recorder. What to look for when you buy—what various types will and will not do.

MAINTAINING HI-FI EQUIPMENT—By Joseph Marshall. Covers the specialized techniques necessary to repair hi-fi equipment. Includes acoustical and mechanical as well as electronic faults.

UNDERSTANDING HI-FI CIRCUITS—By Norman H. Crowhurst. Now have the system best suited to your tastes—and budget. Crowhurst tells you which phase inverter is best, weighs fixed vs. self bias, triode vs. pentode, answers hundreds of other questions.

BASIC AUDIO COURSE—By Donald C. Hoefler. Explains everything about audio from the theory of sound to disc and tape recording techniques.

HOW TO JOIN THE G/L AUDIO-HI FI BOOK CLUB

- Select one book from those listed on the coupon.
- SEND NO MONEY—we will send you the book on approval. If you like it send your remittance for the special club price of $3.75.
- New books are released about every three months. You receive these automatically on the same no-risk plan.
- You may cancel any time after you have accepted four books—no time limit.

MAIL THIS COUPON NOW

Gernsback Library, Inc., Dept. 109C
154 West 14th Street, New York 11, N. Y.

Enroll me in the G/L AUDIO-HI FI BOOK CLUB.

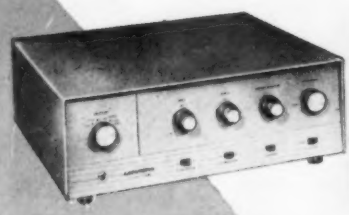
Send me the book checked on approval. (Please check one only)

- ☐ Stereo—How it Works
- ☐ Designing and Building Hi-Fi Furniture
- ☐ Audio Measurements
- ☐ Audio Design Handbook
- ☐ Elements of Tape Recorder Circuits
- ☐ Maintaining Hi-Fi Equipment
- ☐ Understanding Hi-Fi Circuits
- ☐ Basic Audio Course

Name.....
please print
Street.....
City.....Zone.....State.....

Lafayette Superior Quality Hi-Fi Kits

50 WATT INTEGRATED STEREO AMPLIFIER



KT-250 IN KIT FORM **64.50**

LA-250 COMPLETELY WIRED **89.50**

- 50 WATTS MONAURALLY—25 WATTS EACH STEREO CHANNEL
- RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level)
- UNIQUE "BLEND" CONTROL
- PREMIUM EL86 OUTPUT TUBES
- SEPARATE BASS AND TREBLE CONTROLS
- CLUTCH-OPERATED VOLUME CONTROL
- 3RD CHANNEL OUTPUT

A completely new stereo high fidelity amplifier with a high quality of reproduction, versatility of operation, and distinctive styling. A full range of controls enable you to enjoy the utmost in listening pleasure in any situation. Deluxe features include: unique "Blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phase switches. Also provided are outputs for 4, 8 and 16 ohm speakers. Hum-free operation is insured by the use of DC on all preamp and tone control tubes. Harmonic distortion, less than 0.25%. IM distortion, less than 1%. Hum and noise, 74 db below full output. Designed with the kit builder in mind, assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 Stereo Amplifier Kit.....6.45 Down.....Net **64.50**
LA-250 Stereo Amplifier, wired.....8.95 Down.....Net **89.50**

LAFAYETTE PROFESSIONAL STEREO MASTER AUDIO CONTROL CENTER

Solves Every Stereo/Monaural Control Problem!

KT-600 IN KIT FORM **79.50**

LA-600 COMPLETELY WIRED **134.50**

- UNIQUE STEREO & MONAURAL CONTROL FEATURES
- AMAZING NEW BRIDGE CIRCUITRY FOR VARIABLE 3d CHANNEL OUTPUT & COSS-CHANNEL FEED
- PRECISE "NULL" BALANCING SYSTEM
- RESPONSE 5-40,000 CPS ± 1 DB
- 6 CONCENTRIC FRONT PANEL CONTROLS

A REVOLUTIONARY DEVELOPMENT IN STEREO HIGH FIDELITY.

Provides such unusual features as a Bridge Control, for variable cross-channel signal feed for elimination of "ping-pong" (exaggerated separation) effects. Also has full input mixing of monaural program sources, special "null" stereo balancing and calibrating system. 24 equalization positions, all-concentric controls, rumble and scratch filters, loudness switch. Clutch type volume controls for balancing or as 1 Master Volume Control. Has channel reverse, electronic phasing, input level controls. Sensitivity 2.2 millivolts for 1 volt out. Dual low-impedance outputs (plate followers), 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Uses 7 new 7025 low-noise dual triodes. Size 14" x 4⅛" x 10¾". Shpg. wt., 16 lbs. Complete with printed circuit board, cage, profusely illustrated instructions, all necessary parts.

LAFAYETTE KT-600—Stereo Preamplifier kit .....7.95 Down.....Net **79.50**
LAFAYETTE LA-600—Stereo Preamplifier, Wired....13.45 Down....Net **134.50**

Outstanding Design—Incomparable Performance

LAFAYETTE STEREO/MONAURAL BASIC POWER AMPLIFIER KIT

KT-310 IN KIT FORM **47.50**

LA-310 COMPLETELY WIRED **72.50**

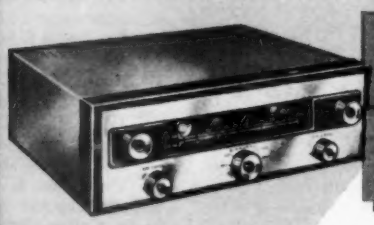
- 36-WATT STEREO AMPLIFIER—18-WATTS EACH CHANNEL
- 2 PRINTED CIRCUIT BOARDS FOR NEAT, SIMPLIFIED WIRING
- EMPLOYS 4 NEW PREMIUM-TYPE 7189 OUTPUT TUBES
- RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS
- LESS THAN 1% HARMONIC OR INTERMODULATION DISTORTION

A superbly-performing basic stereo amplifier, in easy-to-build kit form. Dual inputs are provided, each with individual volume control, and the unit may be used with a stereo preamplifier, for 2-18 watt stereo channels, or, at the flick of a switch, as a fine 36-watt monaural amplifier—or, if desired, it may be used as 2 separate monaural 18-watt amplifiers! CONTROLS include 2 input volume controls, channel Reverse switch (AB-BA), Monaural-Stereo switch, DUAL OUTPUT IMPEDANCES are: 4, 8, 16 and 32 ohms permitting parallel (monaural) operation of 2 speaker systems of up to 16 ohms. INPUT SENSITIVITY is 0.45 volts per channel for full output. TUBES are 2-6AN8, 4-7189; GZ-34 rectifier. SIZE 9-3/16" d (10-9/16" with controls) x 5¼" h x 13¼" w. Supplied complete with perforated metal cage, all necessary parts and detailed instructions. Shpg. wt., 22 lbs.

KT-310 Stereo Power Amplifier Kit.....4.75 Down.....Net **47.50**
LA-310 Stereo Power Amplifier, Wired.....7.25 Down.....Net **72.50**

LAFAYETTE STEREO TUNER KIT

The Most Flexible Tuner Ever Designed



KT-500 IN KIT FORM **74.50**

LT-50 COMPLETELY WIRED **124.50**

- Multiplex Output for New Stereo FM
- 11 Tubes (including 4 dual-purpose) + Tuning Eye + Selenium rectifier Provide 17 Tube Performance
- Pre-aligned IF's
- Tuned Cascode FM
- Dual Cathode Follower Output

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt.

The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for stereo programs. Simplified tuning is provided by magic eye. Automatic frequency control "locks in" FM signal permanently. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10¾" D x 4⅛" H. Shpg. wt., 22 lbs.

KT-500 ..... 7.45 Down ..... Net **74.50**
LT-50 Same as above, completely factory wired and tested.
12.45 Down ..... Net **124.50**

LAFAYETTE RADIO

165-08 LIBERTY AVE., JAMAICA 33, N. Y.
AXtell 1-7000

NEW YORK, N. Y.	BOSTON, MASS.	BRONX, N. Y.	NEWARK, N. J.	PLAINFIELD, N. J.
100 6th Ave.	110 Federal St.	542 E. Fordham Rd.	24 Central Ave.	139 W. 2nd St.
WOrth 6-5300	HUbbard 2-7850	FOrdham 7-8813	MArket 2-1661	PLainfield 6-4718

LAFAYETTE'S
1960 CATALOG
308 GIANT SIZED PAGES

Our 39th Year

The Complete Catalog Featuring
"The Best Buys In The Business"

FOR THE NEWEST AND FINEST IN
STEREOPHONIC HI-FI EQUIPMENT AND SYSTEMS

- TAPE RECORDERS
- PUBLIC ADDRESS SYSTEMS
- AMATEUR EQUIPMENT
- INDUSTRIAL SUPPLIES
- MINIATURE COMPONENTS
- RADIO & TV TUBES AND PARTS
- EXCLUSIVE LAFAYETTE TRANSISTOR & HI-FI KITS

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

CONTAINS HUNDREDS OF EXCLUSIVE LAFAYETTE ITEMS NOT AVAILABLE IN ANY OTHER CATALOG OR FROM ANY OTHER SOURCE — SEND FOR YOUR COPY NOW!

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

FREE

Leaders in Hi-Fi

The most complete selection and largest stocks of hi-fi components and systems—available for immediate delivery at the lowest possible prices. Save even more on Lafayette endorsed "best-buy" complete systems.

EASY PAY TERMS Available on orders over $20
Only 10% down—Up to 18 months to pay

TM-66 STEREO AUDIO ANALYST
11.95

KT-135 4-BAND RECEIVER KIT (Less Cabinet)
18.50

PK-330 4 SPEED CHANGER WITH BRAND NEW GE VR-22 (.7 MIL) DIAMOND STEREO CARTRIDGE
42.50

PA-56 TRANSISTORIZED POWER MEGAPHONE
29.50

PK-331 33⅓ RPM HYSTERESIS TURNTABLE
47.50

PROFESSIONAL COMMUNICATIONS RECEIVER
KT-200 KIT 64.50
HE-10 WIRED 79.95

RW-60 20,000 OHM PER VOLT MULTITESTER
13.50

SK-128 ULTRA-LINEAR 8" DUAXIAL SPEAKER
19.50

Lafayette Radio

"Everything in Electronics"

FREE

CUT OUT AND PASTE ON POST CARD

LAFAYETTE RADIO, Dept. JJ-9
P.O. Box 222, Jamaica 31, N. Y.
SEND FOR THE WORLD'S LEADING ELECTRONICS, RADIO, T.V., INDUSTRIAL, AND HI-FI GUIDE

☐ Send FREE LAFAYETTE Catalog 600

Name .....
Address .....
City ..... *Zone* .... *State* .....

"TAB" Tubes Tested, Inspected, Boxed

Six Months Guarantee!! No Rejects!

NEW & Used Gov't & Mfgrs. Surplus!

Orders $10 or more, Receiving types only ppd, 48 states

OA2	.80	6BJ6	.69	12AT6	.59	1B91	1.00
OB2	.65	6BK7	.99	12AT7	.84	1T26	1.10
OC3	.69	6BL7	1.25	12AU6	.69	4-65A	16.00
OD3	.55	6BN6	.98	12AU7	.69	2D21	2/$1
OZ4	.59	6BQ6	1.19	12AX7	.79	3D23	2.85
1A7	.89	6BZ7	1.25	12BA6	.65	717A	5/$1
1B3	.78	6C4	.43	12BA7	.99	4-125	29.00
1R5	.78	6C9	.69	12BD6	.59	4-250	35.00
1S4	.78	6C86	.80	12BE6	.59	4E27	7.00
1T4	.78	6CD6	1.49	12BF6	.59	4PR60	29.50

Send $1c for Catalog!

1U4	3/$1	6H6	3/$1	12BH7	.99	4X150	5.00
1U5	.73	6J5	.52	12BY7	.98	4X250	35.00
1X2A	.68	6J6	.48	12BZ7	.99	4X500	38.00
3Q4	.68	6K6	.59	12CU6	1.45	5BP1	4.98
3Q5	.86	6K7	.74	12SA7	.94	5BP4	4.98
3S4	.68	6L6	1.19	12SQ7	.89	5T	4.00
3V4	.89	6S4	.59	12SH7	.89	100T	7.00
5R4	.98	6S8	.99	12SJ7	.75	316A	5/$1
5U4	.59	6SA7	.69	12SK7	.94	388A	3/$1
5V4	.89	6SA7	1.19	12SQ7	.84	446B	16.00

Wanted Surplus Electronics from schools & U

5Y3	.59	6SC7	.89	19BG6	2.15	450T	42.00
6AB4	.59	6SG7	.70	19T8	1.16	807	1.00
6AC7	.70	6SH7	.69	25BQ6	1.39	809	3.00
6AG7	.89	6SJ7	.69	25L6	.69	811	3.00
6AH6	.99	6SK7	.72	25W4	.77	812	3.00
6AK5	.69	6SL7	.89	25Z5	.63	813	9.00
6AL5	2/$1	6SN7	2/$1	25Z6	.75	814	3.45
6AQ5	.63	6SQ7	.74	EL34	3.49	815	2.75
6AS7	3.00	6SR7	.79	EL37	2.49	826	.59
6AT6	.49	6T8	.98	35L6	.69	829B	8.00

Wanted 80L tl tubes! Top $ $ $ Paid.

6AU4	1.10	6U8	.98	35W4	.49	832A	7.00
6AU5	1.10	6V6GT	.70	35Y4	.69	866A	1.75
6AU6	.69	6W4	.79	35Z5	.63	1625	5/$1
6AX4	.79	6W6	.89	50A5	.69	6146	4.00
6BA6	.59	6X4	2/$1	50B5	.69	5879	.98
6BA7	1.00	6X5	.49	50C5	.69	5881	2.70
6BD6	.69	6Y6	.97	50L6	.69	6550	3.90
6BE6	.59	7N7	.89	KT66	3.29	5654	1.00
6BG6	1.50	12AL5	.59	75	.89	5894	12.00
6BH6	.72	12AQ5	.75	80	.59	7193	10/$1

TUBES WANTED! WE BUY! SELL & TRADE!

NEW DC POWER for TRANSISTORS!!

New low-cost 25 volt one amp filtered 1% Ripple Power Supply. Same as specified in Transistor Manuals G.E., RCA, CBS. Ideal for powering transistor circuits, rugged & small in size! Preassembled kit U-build B25VIACK $10, or assembled B25VIACB $12.

KITS! "TAB" THE BEST KITS!

All Kits Contain Most Popular Values & Sizes

Kit 2 Eng. Parallel Rules	Kit 5 Sub-Min Tubes
Kit 35 Precision Resistors	Kit 40 Standoff Insulators
Kit 10 Switches	Kit 35 Power Resistors
Kit 75 Resistors ½-1½W	Kit 75 Mica Condensers
Kit 150 Carbon Resistors	Kit 5 Crystal Diodes
Kit 25 Panel Lamps	Kit 100 Fuses, Assorted
Kit 12 Electrolytic Cond's	Kit 100 Electrolytic Condsr.
Kit 18 Volume Controls	Kit 10 Germanium Diodes
Kit 56 Tube Sockets	Kit 5 FT243 Xtal Holders
Kit 65 Tubular Condensers	Kit 10 Silicon Diodes
	Kit 5 Microswitches
Kit 500 Lugs & Eyelets	Kit 10 Wheat Lamps
Kit 10 Bathtub Oil Cond's	Kit 3 Transistor Xfmrs
Kit 5 lbs. Surprise Pckg.	Kit 3 NPN Transistors
Kit 10 Xmttr Mica Condsr.	Kit 4 Asstd Rectifiers
Kit 3 Phone Transistor Xfmrs	Kit 4 Asstd Zeners
Kit 3 Searchlights	Kit 4x50 Ft Hookup Wire
Kit Circular Slide Rule	Kit 2 Veeder Counters
Kit 12 Aigtr Clip Asst'd.	Kit 2-Computer Toroids
Kit 2 Sklite Pnls 6x12"	Kit High Gain XTAL Mike
Kit 5 Pcs. Wrench Set	Kit 10 pr. Phono Pgs. Jaks

BUY 10 KITS—GET ONE FREE! **EACH KIT 99¢**

NEW "TEKSEL" SELENIUM RECTIFIERS

FULL WAVE BRIDGE RECTIFIERS. *ONE YEAR GTD!*

AMP. CONT.	18VAC 14VDC	36VAC 28VDC	72VAC 56VDC	144VAC 118VDC
1AMP	$ 1.30	$ 2.00	$ 4.90	$ 9.45
2AMP	2.15	3.00	6.25	12.50
3AMP	2.90	4.00	8.60	16.75
6AMP	4.15	8.00	11.75	36.15
10AMP	6.90	12.15	26.30	48.50
15AMP	9.90	19.00	40.00	66.60
24AMP	15.00	29.45	57.50	108.45

FOR BEST BUYS! "TAB" for BARGAINS

BC696 3 to 4 Mc's Xmttr Good Condition..... $5.95
AN—ARR2 Rcvr As Is Good for Parts..... $1.59
RDZ/USN 200-400 Mc's Rcvr less Tubes..... $25.00
RAX Rcvr covers 4 Bands 1.5 to 9 Mc's Super-Het 8 tubes, has BFO Vernier Ltd Qty!..... $24.00
BC653/130 to 200W Xmttr Phone or Cw 2 to 4.5 Mc's Includes 12V/Dynmtr 5 Channels..... $39.00
"Irish" Tape 1200' HiQity Gtd $1.59 @..... 6 for $9
"Irish" Tape Mylar 2400 ft Best Qity $4.49, 3 $12
Scopserscope Tube 2" $5 @..... 2/$9
2N277 $4.50; 2N278 $5.50; 2N441 $3; 2N442 $5

NEW SILICON 500MA RECTIFIERS

Input Working Range RMS/ACV Res. or Cap.

rms/piv	rms/piv	rms/piv	rms/piv
35/50 36¢	70/100 54¢	140/200 63¢	210/300 81¢
rms/piv	rms/piv	rms/piv	rms/piv
280/400 .99	350/500 $1.25	420/600 $1.60	490/700 $1.90
rms/piv	rms/piv	rms/piv	rms/piv
560/800 $2.00	630/900 $2.40	700/1000 $3.25	770/1100 $3.90

Example: 140V at 500Ma each 63¢ less 20% on $10 orders or 20 for $10 PPD

Buy Qtys Deduct 20% on $10 orders

Use in Bridge or C. T. up to 7.0ma DC

Postpaid 48 states order $10

TRANSISTORIZED DC POWER!

HI-EFFICIENCY DC to DC to 450 VDC "TABSTAT" KIT or BUILT

Output 450 & TAP 250VDC at up to 150 MA/Up to 70 Watts 80% efficiency; ripple 0.2%; low idle current one amp silicon rectifiers, oil condensers, toroid transf. fused & short circuit proof. Regulation 5% at 20 to 100% load!! Small in size! Quiet! Light wgt! Low-priced gtd "TABSTAT" TR1245CB built $35. Pre-Assembled U-Build kit TR1245CK Only $30. Six V Input. TR645CB $35 or Kit TR645CK $30. "TABSTAT" 250VDC @ 100MA/12V in TR1225CB $27, Kit TR1225CK $24, 6V input TR6125CB $27, Kit TR625CK $24.

NEW Selenium Radio & TV Rectifiers! GTD.

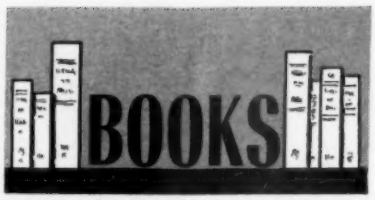
65Ma 45¢, @ 6 for $2; 100Ma 45¢ @; 12/$5, 250Ma 65¢ @; 10/$6, 300Ma 88¢ @; 10/$8, 500Ma $1 @, 10/$8, 25/$18

Orders of $10 or More, Postpaid 48 states!

"TAB" TERMS: Money Back Guarantee! Our 14th year. $2 min. order F.O.B. N.Y.C. Add shpg charges or for C.O.D. 25% Dep. Prices shown subject to change.

111-JW LIBERTY ST., N.Y. 6, N.Y.

Send 10c PHONE: RECTOR 2-6245 *for Catalog*



LOGICAL DESIGN OF ELECTRICAL CIRCUITS, by Rene A. Higonnet and Rene A. Grea. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y. 6 x 9 in. 220 pp. $10.

This book is for engineers who work with computers, automation or switching networks. The first few chapters introduce the reader to Boolean algebra. This equips him to understand switching networks and shows him how to simplify complex circuits. Many tables, examples and illustrations are included.

After a study of various circuits, the last chapters analyze relays, rectifiers and tubes as switches.

LOW-FREQUENCY AMPLIFIERS, edited by A. Shure, PhD, EdD. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 79 pp. $1.80.

This book is an introduction to the field of audio and hi-fi. It gives the basic facts of tubes and transistors, and shows how to use them in circuits.

Although the introductory chapter speaks of the importance of frequencies under 20 cycles, the text is concerned only with the range of human hearing, and the lowest frequency mentioned in a problem is 50 cycles.

Examples and formulas are given to aid the student. Decibel, push-pull, class B, load line, transistor bias are among the concepts discussed and explained.

ANALYTICAL TRANSIENTS, by T. C. Gordon Wagner. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 5¾ x 9 in. 202 pp. $8.75.

This is an excellent book for advanced study of networks and transients. The author presumes an elementary knowledge of these topics and of mathematics. He introduces the reader to Fourier analysis and Laplace transforms, as well as complex variables. These are powerful tools in the study of advanced theory.

Numerical examples are worked out to illustrate theory and formulas.

FUNDAMENTALS OF ELECTRICAL ENGINEERING (2nd Edition), by Fred H. Pumphrey. Prentice-Hall, Inc., Englewood Cliffs, N. J. 6 x 9 in., 534 pp. $8.50

Starting with fundamentals, the author covers dc and ac (including polyphase) circuits, principles of magnetism and electrical measurements. Then the book proceeds to transformers, motors and generators, amplifiers, tube circuits, etc.

Because of its wide coverage and clear analyses, the book is recommended for students and specialists in other engineering fields who work with electrical devices and circuits. It is especially strong on electrical machines, measurements, amplifiers and controls. Among other topics are illumination, hf heating, industrial wiring, etc.—*IQ*

RADIO CIRCUITS, by W. E. Miller. Fourth Edition, revised by E. A. W. Spreadbury. Iliffe & Sons, Ltd., London, England. 5½ x 8½ in. 172 pp. 15 shillings net.

Very little previous training in radio is needed to understand this book. Written in simple language, it explains the principles of FM and AM radio, stage by stage. Each brief chapter covers a single topic (detection, negative feedback, transistors, etc.).

Typical schematics for each portion of a receiver are explained in detail and show suggested component values.

MAGNETIC TAPE RECORDING, by H. G. M. Spratt. MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 5¼ x 8½ in. 319 pp. $8.50

Sound recording is but one of many important magnetic-tape applications. Tape is also used for data processing and storage, automatic control, waveform analysis, video recording, etc. This book can help engineers who work in such fields.

A good introduction to principles of magnetism and electro-acoustics is followed by recording principles. Chapters on tape manufacture and testing follow. A long chapter discusses components of tape machines and how they are adjusted. The book is interesting and easy to read and contains a minimum of mathematics. Diagrams and photos aid the text.—*IQ* END

SUPER MAGNET SUPER SAVING!

Buy this Little Giant magnet, most powerful made, a sensational bargain! The low price of $1.95 is less than 50% of what you'd pay for this magnet. Experimenters, hobbyists will find hundreds of uses for this powerful 4 oz. Alnico permanent magnet. LIFTS 5 lbs. EASILY. Limited quantity. Order several today. Measures 1¾ x 1½". Item No. 86 $1.95

Special Bargain (Shp. Chgs. 10c)

250 POWER TELESCOPE LENS KIT

Make your own high powered 6 ft. telescope! Kit contains 2" diam., 75" focal length, ground and polished objective lens and necessary eye pieces. Magnifies 50x to 250x. Full instructions.

ITEM NO. 123 $3.45 (Shp. Chgs. 10c)

AMAZING BLACK LIGHT

250-watt ultra-violet light source. Makes fluorescent articles glow in the dark. Fits any lamp socket. For experimenting, entertaining, unusual lighting effects.

Ship. wt. 2 lbs. ITEM NO. 87 $3.45 (P. P. & Hdlg. Chgs. 35c)

HUDSON SPECIALTIES CO., 160 W. 14th St. Dept. RE-10-59, New York 7, N.Y.

I am enclosing full remittance for items circled below. (Be sure to include shipping charges.)

87 33 86 123

Name ..... Please Print Clearly

Address .....

City ..... Zone..... State.....

WATTHOUR METER

Leading makes—reconditioned. Ideal for trailer parks. 100-110 volts, 60 cycles, 2-wire A.C. 5 amp. Heavy metal case 8½" x 6¼" x 5". Easy to install. Ship. wt. 14 lbs.

ITEM NO. 33 NOW ONLY $4.95

(P.P. & Hdlg. Chgs. $1.25)

SCHOOL DIRECTORY

GET INTO
ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic and advanced courses in theory and laboratory. Assoc. degree in electronics in 29 mos. B.S. in electronic engineering obtainable. ECPD accredited, G.I. approved. Graduates in all branches of electronics with major companies. Start February, September. Dorms, campus. High School graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
Dept. C Valparaiso, Indiana

REALIZE YOUR DREAM

Become a graduate Electronics Engineer. Share rewards awaiting college men . . . higher income, rapid advancement. Important firms interview seniors here regularly.

Electrical Engineer in 27 Months

B.S. degree in Electrical (Electronics or Power major), Mechanical, Civil, Chemical, Aeronautical Engineering. *In 36 Months* a B.S. in Business Administration (General Business, Accounting, Motor Transport Management majors). For earnest, capable students. Small classes. More professional class hours. Mature students. Well-equipped labs. Modest costs. Veteran approved. Year-round operation. Enter Jan., Mar., June, Sept. *Write J. G. McCarthy, Director Admissions, for Catalog and "Your Career" Book.*

TRI-STATE COLLEGE
24109 College Ave. Angola, Ind.

ENGINEERING DEGREES

E.E.
Option Electronics or Power
Mechanical, Civil & Physics
Also in Liberal Arts & Business Administration
Earned through
HOME STUDY
Resident Classes Also Available if Desired
PACIFIC INTERNATIONAL COLLEGE OF ARTS & SCIENCES
Primarily a Correspondence School
5719-M, Santa Monica Blvd., Hollywood 38, Calif.

PACIFIC INTERNATIONAL C.A.S.

ELECTRONICS

PREPARE FOR A GOOD JOB!
BROADCAST ENGINEER
RADIO SERVICING AUTOMATION
TELEVISION SERVICING BLACK & WHITE—COLOR
APPROVED FOR VETERANS AND SURVIVORS OF VETERANS
BUILDING AIR CONDITIONED
SEND FOR FREE LITERATURE
BALTIMORE TECHNICAL INSTITUTE
1425 EUTAW PLACE, BALTIMORE 17, MD.

ELECTRONICS

Prepare for unlimited opportunities in electronics!
ENGINEERING DEGREE IN 27 MONTHS
B.S. Engineering degree (27 mo.): Mathematics, Electrical Engineering, TV; advanced Radio Theory and Design. **B.E. (36 mo.):** Aeronautical, Chemical, Civil, Electrical, Mechanical, Metallurgical Eng. **B.S. (36 mo.):** Math., Chem., Physics. Also preparatory courses. Earn board; G.I. approved. 20 bldgs., dorms, gym. Enter Dec., March, June, Sept. Catalog. Keeping pace with progress.
INDIANA TECHNICAL COLLEGE
15109 E. Washington Boulevard, Fort Wayne 2, Indiana

CODE SENDING RECEIVING SPEED

Be a "key" man. Learn how to send and receive messages in International Morse code. Communicate with operators around the globe. Learn at home quickly through famous Candler System. Used by best operators. Qualify for Amateur or Commercial License. Write for FREE BOOK.
CANDLER SYSTEM CO.
Dept. 3-L, Bx. 9226, Denver 20, Colo. USA

ENGINEERING
HOME STUDY COURSES

Courses written by world authorities in all branches of engineering and science and proved successful by thousands of our graduates. One hour each day in your spare time will start you off to higher pay, security and prestige. Personalized instruction methods ensure rapid progress. Fill in the coupon and indicate the course of interest. We will send you a complete outline of the course and a booklet describing the Institute and our advanced teaching methods.

RADIO
ELECTRONICS
TELEVISION
CIRCUIT MATHEMATICS
ELECTRICAL ENG.
TELEPHONY
CIVIL ENG.
SURVEYING
ARCHITECTURE
FORESTRY
MINING
STRUCTURAL
MECHANICAL ENG.
INDUSTRIAL ENG. & MANAGEMENT
REFRIGERATION
DRAFTING
PLASTICS
AERONAUTICAL ENG.
HIGH SCHOOL
CHEMICAL
MATHEMATICS
JOURNALISM
ACCOUNTING

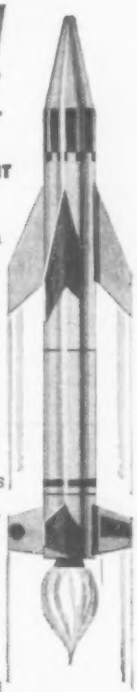
MAIL THIS COUPON TODAY

CANADIAN INSTITUTE OF SCIENCE & TECHNOLOGY LIMITED
730 Century Bldg., 412, 5th St. N.W., Wash., D.C.
NAME.....
ADDRESS.....
CITY.....STATE.....
COURSE OF INTEREST.....
Canadians: Send to C.I.S.T., 730 Garden Bldg., 263 Adelaide St. West, Toronto, Ontario.

C. I. S. T.

prepare for your career in

ELECTRICAL ENGINEERING
ELECTRONICS
COMPUTERS
RADIO-TV



At MSOE, you can equip yourself for a career in many exciting, growing fields: **MISSILES RADAR • AUTOMATION RESEARCH • DEVELOPMENT ELECTRICAL POWER AVIONICS • ROCKETRY**

When you graduate from the Milwaukee School of Engineering, you are prepared for a dynamic career as an Electrical Engineer or Engineering Technician. Under a faculty of specialists, you gain a sound technical education in modern, completely equipped laboratories and classrooms. As a result, MSOE graduates are in great demand and highly accepted by industries nationally.

At MSOE you will meet men from all walks of life and all parts of the country — some fresh out of high school or prep school, others in their twenties — veterans and non-veterans.

You can start school in any one of four quarters and begin specializing immediately. Engineering technicians graduate in 2 years with an *Associate* in *Applied Science* degree. For a *Bachelor of Science* degree in Engineering, you attend 4 years. A 3-month preparatory course also is available.

FREE CAREER BOOKLET!
If you're interested in any phase of electronics, radio or television, be sure to look into the programs of study offered by the Milwaukee School of Engineering. Just mail the coupon.

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RE 1059, 1025 N. Milwaukee St.
Milwaukee, Wisconsin

Please send FREE Career Booklet. I'm interested in ☐ Electrical Engineering;
☐ Electronics ☐ Computers
☐ Electrical Power ☐ Radio-TV
☐ Mechanical Engineering.

PLEASE PRINT
Name.....Age.....
Address.....
City.....Zone.....State.....
☐ I'm eligible for veterans education benefits.
MS-123

BARRY
October Specials

- **Adjustable Glass Capacitor**—.5 to 5 Mmfd. 1" H—¼" Dia.—10 for $1.00.
- **Cardwell 150 Mmfd. Fixed Padding-Capacitor**—Jobber-boxed. $1.00.
- **Brand new Vector Sockets**—7 or 9 pin miniature (specify). 50¢ each.
- **3 Digit Veeder-Root Counter $1.00—SPST Knife Switch**—Jobber boxed $1.00 (10 for $8.00).
- **Intercom Cable-7 Conductor (Color-Coded)**—⅜" Dia. $7.50 per 100 ft. ($60.00 per 1,000 ft. reel).
- **Dummy Load Type TS-78U. Standard Coax input.** Excellent for VHF, lo-pwr use with three pilot bulbs. Compact. Excellent value $1.00 each (3 for $2.50).
- **Micamold 40 Mfd. @ 300 VDC Capacitor**—40¢ each (10 for $3.00).
- **GE High-Voltage Power Supply**—115 Volt @ 60 CPS input. Output approx. 6500 VDC. Low current. Relay rack mounted—Unused. $15.00 (less tubes).
- **.2 Mfd @ 10KV DC GE Pyranol Capacitors. $4.95.**
- **RCA Xfmr.**—Pri: 117 Volts @ 60 CPS. Sec: 38 Volts @ 150 Ma. $1.25.
- **Tobe Filterette Heavy-Duty Line Filter**—250 VAC @ 10 amps. $2.50.
- **Electro-Voice Xtal. Mike**—Model 915. Brand new/orig. mfrs cartons. $4.95.
- **Acorn Socket**—15¢ each.
- **Five-Way Binding Posts** (red or black—specify)—22¢ ea.
- **Closed-Circuit TV Camera & Monitor**—Low cost professional equip. @ moderate cost. Brand new. Write for brochure.
- **Gelosо Tape Recorder. New. $179.95**—(Brochure)
- **Step-Down Transformer**—Pri: 220/240 CPS Sec: 115 V. @ 5.2 amps. $5.95.
- **Ohmite 50 Watt Rheostat**—6 Ohms—3 Lugs 75¢
- **Ceramic Rotary Switch**—3PDT 35¢.
- **Electric Shoe Dryer**—115 VAC-UL approved. (Reg. $29.95)—Deluxe item. Makes excellent gift for golfers, etc. In orig. cartons—new. $9.95.
- **High-Voltage Transformer**—Pri: 115 VAC @ 60 CPS Sec: 20,000 Volts @ .75 KVA (approx. 30 Ma.) 67 lbs. $15.00 (New, Boxed)
- **7.5 KVA Isolation Transformer**—Pri: 115/or 230/1/60 CPS with 10% taps. Sec: 115/1/60 CPS @ 7.5 KVA.-500 lbs. (Value $500.00). Unused. $150.00.
- **Scintillation Counter**—Brand new. Orig. cartons. Ready to operate with fresh set batteries. Reg. $245.00 Special $49.95. Ten times more sensitive than usual Geiger Counter.
- **Evans Gasoline or Kerosene Heaters**—Orig. pack. Special $5.00.
- **Dual Emergency Lamp**—Use as portable lamp or attach to 110 VAC or DC line. When power fails, lamp lights. 7½" Dia. 7½" High. $3.95 (less battery).
- **Telephone Wire**—3,000 ft. reel $12.00. $22.50 for two reels.
- **DC METERS—Model DD-6**—6" Square Meters. (Worth up to $80.00 ea.—Ltd. Qty.) Ammeters: 0-1.5, 0-5, 0-10, 0-2000 (no shunt), 2000 0-2000 (no shunt). Voltmeters: 0-150, Kilovoltmeters: 0-5, 0-50. Milliammeters: 0-7.5, 0-500, 0-750, 0-1500 PRICE: $6.50 each—any range.
- **4X150A @ $7.00/ 3B28 @ $3.50/ 3E29 @ $6.00/ 829B @ $8.00/ 813 @ $8.50/826 @ 60¢/ 404A @ $7.00/ RK72 @ 25¢/ 316A @ 20¢/ 838 @ $1.00.** Write for free tube order blanks. "WRITE FOR GREEN SHEET CATALOG." **Export and industrial orders invited.**

BARRY ELECTRONICS CORP. **TUBE HQS.** HAM - TV INDUSTRIAL RADIO

• HIGHEST QUALITY • TOP BRAND NAMES ONLY • • BOXED • LOWEST SENSIBLE PRICES • • GUARANTEED •

All prices F.O.B. N.Y.C. Specify method of shipment. All merchandise insured and guaranteed for cost of mdse. only.

Open Monday to Saturday—come in and browse—we are near Prince St./BMT Station—Spring St./IRT Station. 1 flight up—20,000 sq. feet of values. Thousands of unadvertised specials. Phone: WAlker 5-7000.

BARRY ELECTRONICS CORP.
512 Broadway, Dept. RE-10, N.Y. 12, N.Y.

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

Acoustic Research Inc. 140
Acro Products Co. 124
Airex Radio Corp. 148
Alco Electronics Mfg. Co. 134
Allied Radio Corp. 16-17, 27
American Radio & Television Co. 86
Amperex Electronic Corp. 138
Amphenol-Borg Electronics Corp. 98
Arkay Radio Kits Inc. 122
Astatic Corp. 131
Atlas Sound Corp. 116
Audion 144

B & K Mfg. Co. 85, 121
Barry Electronics Corp. 156
Bell Telephone Labs. 21
Blonder-Tongue Labs. 115
Bogen (David) Co. Inc. 148
Brooks Radio & Television Corp. 147
Burstein-Applebee Co. 123

CBS Electronics 12
Capitol Radio Engineering Institute 92-95
Carston Studios 157
Centralab Div. of Globe Union 10
Century Electronics Co. Inc. 108-109
Charles Engineering Co. 132
Cisin (H. G.) 114
Clarostat Mfg. Co. Inc. 81
Cleveland Institute of Radio Electronics 11, 137, 139, 141, 143, 145
Colordaptor 157
Coyne Electrical School 23, 96, 142
Custom Design of Westchester 85

DeVry Technical Institute 7
Dressner 157
Duotone Co. Inc. 140
Dynaco Inc. 126

Electro Products Labs. 146
Electro-Sonic Labs 24
Electro-Voice Inc. Inside Back Cover
Electronic Chemical Corp. 123
Electronic Instrument Co. (EICO) 31-32
Electronic Publishing Co. Inc. 157
Electronic Technical Publishing Co. 144
Electronic World Inc. 134
Entron Co. 134
Erie Resistor Corp. 28

Fisher Radio Corp. 87
Foreign Components Co. 145

General Electric Semiconductor Div. 119
General Instrument Distributor Div. 77
Genex Corp. 146
Gernsback Library Inc. 151, 156
Grantham School of Electronics 15

ELECTRONICS TECHNICIANS

Senior level positions are immediately available at Thiokol's Utah Division, where large solid-propellant rocket engines for MINUTEMAN and other advanced projects are being developed and tested.

A minimum of 5 years electronics experience is required, preferably in digital and analog data acquisition equipment or instrument repair and calibration.

Here is the rare and desirable combination of challenging work assignments, with a dynamic and growing organization, in a geographical setting offering uncrowded living conditions and unexcelled recreational opportunities.

Please direct your resume to

Thiokol
CHEMICAL CORPORATION
UTAH DIVISION
Personnel Office:
120 South Main Brigham City, Utah

What do YOU know about PRINTED CIRCUITS?

Yes, you! Printed circuits are pushing bulkier conventional chassis off center stage. They're being used more and more today—and that pace will step up tomorrow. You'll have to know more about them if you want to stay afloat in electronics. Let this latest Gernsback Library book help you.

Practically an encyclopedia on the subject—it tells how printed circuits developed, how they're made commercially, how you can make them, what components to use with them, how to use them in practical electronic equipment, how to maintain and repair them. Quite a book! Get your copy at your distributor today.

PRINTED CIRCUITS
G/L Book No. 81
By Morris Moses.
Paper cover ed.....$2.90
Hard cover ed.....$4.60

Other G/L Books you'll want to own

(Paper cover editions)

No. 80—Stereo—How it Works.....$2.90
No. 79—Designing and Building Hi-Fi Furniture $2.90
No. 78—Rapid Radio Repair $2.90
No. 77—Guide to Mobile Radio.....$2.85
No. 76—Servicing Transistor Radios..$2.90
No. 75—Transistors—Theory and Practice $2.95
No. 74—Model Radio Control.....$2.65

SEE YOUR DISTRIBUTOR—OR MAIL THIS COUPON TODAY

Gernsback Library, Inc. Dept. 109
154 West 14th St., New York 11, N. Y.

Please send me the books checked below postpaid.

Printed Circuits No. 81 ☐ Hard cover ed. ☐ Paper cover ed.

Hard cover ed.: ☐ 80 ☐ 76 ☐ 79 ☐ 75
Paper cover: ☐ 78 ☐ 74 ☐ 77

name_____
please print
street_____
city_____ zone____ state_____

ADVERTISING INDEX *(Continued)*

Hartley Mfg. Co. 145
Heald Engineering College 157
Heath Co. 66-73, 75
Homewood Industries 145
Hudson Specialties Co. 154

Indiana Technical College 125
International Business Machines (IBM) 128-129
International Correspondence Schools 158

Jensen Industries 120
Jersey Specialties Co. 130

Key Electronics Co. 144
Kingdom Products 138
Kingston Electronics 74

Lafayette Radio 152-153
Lansing (James B.) Sound Inc. 18
Letkon Inc. 125

Mallory (P. R.) & Co. Inc. 14
Marlo Electronics 125
McGraw-Hill Book Co. 144
Merit Coil & Transformer Corp. 120
Metropolitan Electronics 117
Micro Electron Tube Co. 127
Moss Electronic Inc. 100-101

National Radio Institute 3, 19-20, 148
National Schools 5
North American Philips Co. Inc. 120

Olson Radio Corp. 149
Opportunity Adlets 150
Oxford Components Inc. 142

Paco Electronics Co. Inc. 110
Perma-Power Co. 117
Philco Techrep Div. 22
Pickering & Co. Inc. 142
Picture Tube Outlet 145
Progressive Edu-Kits Inc. 133
Pyramid Electric Co. 136

RCA Electron Tube Div. ..... Back Cover
RCA Institutes 103
RCA Test Equipment 116
Radio Shack Corp. 135
Rinehart & Co. Inc. 99, 140
Rockbar Corp. 105
Rohn Mfg. Co. 97

Sams (Howard W.) & Co. Inc. 13, 124
Scott (H. H.) Inc. 26
Seg Electronics 107
SENCORE (Service Instruments Corp.) 137, 139, 141, 143
Sherwood Electronics Labs Inc. 80
Simpson Electric Co. 83
Sonic Industries Inc. 96
Sonotone Corp. 82
Sprayberry Academy of Radio-Television 29
Superex Electronics 150
Supreme Publications 149
Sylvania Electric Products Inc. 25

TAB 154
Tarzian (Sarkes) Inc. 138
Thiokol Chemical Co. 156
Triplett Electrical Instrument Co. ..... Inside Front Cover
Tung-Sol Electric Co. 8

United Audio Products 146
University Loudspeakers Inc. 30

Vaco Products Co. 146
Van Nostrand (D.) Co. Inc. 9, 122
Vidaire Electronics Mfg. Corp. 146
Vis-U-All Products Co. 114

Weathers Industries 116
Winegard Co. 78-79

Xcelite Inc. 114

SCHOOL DIRECTORY PAGE 155

Baltimore Technical Institute
Canadian Institute of Science & Technology
Candler System Co.
Indiana Technical College
Milwaukee School of Engineering
Pacific International College of Arts & Sciences
Tri-State College
Valparaiso Technical Institute

BRANCH ADVERTISING OFFICES: Chicago: 5500 N. Menard Ave., Chicago, Ill., Spring 4-1444. **Los Angeles:** Harker-Husted-Coughlin, 600 South New Hampshire, Tel. DUnkirk 7-2328. **San Francisco:** Harker-Husted-Coughlin, 444 Market St., Tel. GArfield 1-2481.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, London E.C. 4.

Printed in the United States of America

ELECTRONICS ENGINEERING-TECHNICIANS

AT HEALD'S YOU LEARN BY ACTUAL PRACTICE IN MODERN LABORATORIES . . . AND GET TOP PAY JOBS.

Bachelor of Science Degree, 30 Months

- ☐ Radio-TV Technician including Color TV (12 Months)
- ☐ Electronics Technician (12 Months)
- ☐ Industrial Electronics Technician (12 Months)
- ☐ Electronics Engineering (B.S. Degree)
- ☐ Electrical Engineering (B.S. Degree)
- ☐ Mechanical Engineering (B.S. Degree)
- ☐ Civil Engineering (B.S. Degree)
- ☐ Architecture (B.S. Degree)

Heald College ranks FIRST West of the Mississippi in "Who's Who in America"

Approved for Veterans
DAY AND EVENING CLASSES
Write for Catalog and Registration Application.
New Term Starting Soon.

HEALD'S
ENGINEERING COLLEGE
Established 1863
Van Ness at Post, RE
San Francisco, Calif.

Your Name _____

Address _____

City _____

State _____

MAIL ORDER HI-FI

You can now purchase all your HI-FI from one reliable source and be assured of perfect delivery. Carston makes delivery from NY stock on most Hi-Fi, Recorders and tape within 24 hours. **SEND US A LIST OF YOUR HI-FI REQUIREMENTS FOR OUR WHOLESALE QUOTATION** and our **FREE** wholesale catalogue.

CARSTON STUDIOS 125-RD E. 88 St. New York 28, N. Y.

TAPE RECORDERS

HI-FI COMPONENTS
SLEEP LEARN KITS

MERITAPE Low cost, high quality recording tape, in boxes or cans.

UNUSUAL VALUES
FREE
1959 CATALOG

DRESSNER, 69-02RE 174 St., Flushing 65, N.Y.

PROFESSIONAL technicians use *Dave Rice's* OFFICIAL ORDER BOOKS for every TV-RADIO service call

This is the businesslike approach to service record keeping. Triplicate forms serve as order form, invoice and office record, with spaces for complete information on every job. Separate listings for receiving tubes, pix tube, parts, serial numbers, labor and tax charges, signatures, etc. 75c a book, $6.50 for dust-proof box of 10. In stock at your distributor.

Write for your *free* folder describing Dave Rice's OFFICIAL ORDER BOOKS, including an actual size sample copy of the handy order form.

* * * *

For customer's prices on every replacement part, plus flat rate and hourly service charge data, regional and national, Dave Rice's OFFICIAL PRICING DIGEST, listing over 63,000 items. $2.50.

ELECTRONIC PUBLISHING CO., INC.
180 N. WACKER DRIVE
CHICAGO 6, ILLINOIS

CONVERT TO COLOR TV

COLORDAPTOR—A simple 10-tube circuit and rotating color wheel converts any size B & W TV to receive **compatible color TV.**

COLORDAPTOR — Easily attached to any TV set, does not affect normal operation, often built from parts experimenters have on hand, BRILLIANT COLOR!

ONLY $1.95

Complete booklet—gives theory of operation, all construction details, schematic, and sample color filters.

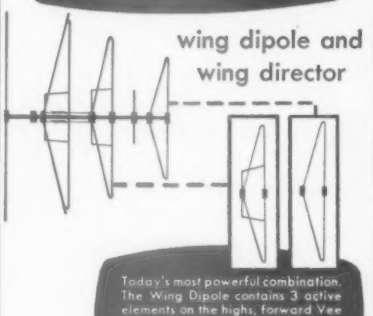
Essential Parts Kit—All Special Parts—Coils, Delay Line, Crystal, Color Filters

Up to 16" Sets— $19.95 17" and Larger $20.95

Other Kits, Wired Chassis, Motors Available

COLORDAPTOR 325 Melville St., Palo Alto, Calif. 149 Hillside, Berkeley Hgts, N.J.

ANOTHER GREAT TRIO® TV ANTENNA FEATURE



Today's most powerful combination. The Wing Dipole contains 3 active elements on the highs, forward Vee to the low band section, plus integrated director. The Wing Director obtains maximum results from the Wing Dipole.

Just one of the features that makes Trio the most advanced TV Antennas in the world. Choose from Trio's complete Zephyr and Color Series Antennas.

TRIO® Manufacturing Company
GRIGGSVILLE, ILLINOIS

BIG REWARDS

for the most-wanted men in Radio-TV-Electronics

General Electronics Technician | Radio-TV Engineer | Radio-TV Service Manager | Industrial Electronics Technician | Electrical Engineering Technician | Electrical Draftsman

That's right! There *are* big rewards for the most-wanted men in Radio-TV-Electronics.

You can be one of these men. With the right training you can qualify for a big-pay job in a vital industry. You can start yourself on an exciting, rewarding career in a field that offers unlimited opportunities.

But you must be thoroughly trained. You must know more than wires and tubes. You must *think* in electronic terms.

There's no short-cut to success in Radio-TV-Electronics. But there is a simple, sure way . . . the I.C.S. way.

I.C.S. is the world's oldest and largest technical training school. Sixty-seven years of experience in training 6½ million students have made the I.C.S. system a success-proven method of home study. Today, there are more trained men from I.C.S. in supervisory and management jobs than from any other school.

Up-to-the-minute I.C.S. Courses make electronic fundamentals clear, easy-to-follow. *Personalized* guidance helps you through each step.

You study at home — in your spare time — at your own pace. Everything you learn is practical, usable. Courses are prepared by experts who know what *you* need to know to go places.

Join the ranks of the most-wanted men in Radio-TV-Electronics. Your first step is to send for your free I.C.S. Career Kit. You have nothing to lose. You can gain an exciting career in the fastest-growing industry of all time.

HOW WILL YOUR I.C.S. SUCCESS STORY SOUND?

"I took my diploma from your school in Radio Operating in 1947. In 3 years I became chief engineer of WKOK in Sunbury, Pa. Then I came to California as Audio Engineer for ABC in Hollywood. I still hold this position. I will always be grateful for your help in getting me in the type of profession that has so much to look forward to." *William R. Dreese*

"I had been in the radio-repair business for 30 years, when I enrolled in the I.C.S. Television Servicing Course.

"Now I am able to approach a television job in a systematic manner, while others are still operating on the hit-or-miss level." *Kelsey G. Cobb*

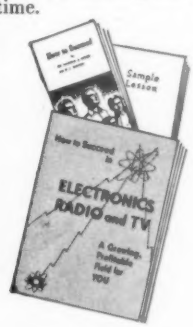
"Up to the time I enrolled, my interest in electronics was purely a hobby, but before completing my course I was able to do a considerable amount of radio work. Now I have a good part-time business." *George A. Chase*

Send the coupon below for your *free* I.C.S. Career Kit!

1 "How to Succeed," 36-page guide to advancement.

2 Opportunity handbook for the field of your choice.

3 Sample lesson (Math) to demonstrate I.C.S. method.



For Real Job Security—Get an I.C.S. Diploma! **I.C.S., Scranton 15, Penna.** **Accredited Member, National Home Study Council**

INTERNATIONAL CORRESPONDENCE SCHOOLS

ICS

BOX 02465J, SCRANTON 15, PENNA. (Partial list of 257 courses)

Without cost or obligation, send me "How to Succeed" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):

RADIO TELEVISION ELECTRONICS
- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Practical Telephony
- ☐ Radio-TV Servicing

BUSINESS
- ☐ Cost Accounting
- ☐ Managing a Small Business
- ☐ Purchasing Agent

DRAFTING
- ☐ Electrical Drafting

HIGH SCHOOL
- ☐ High School Diploma
- ☐ Good English
- ☐ High School Mathematics

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Elec. Engr. Technician
- ☐ Elec. Light and Power
- ☐ Practical Electrician
- ☐ Professional Engineer (Elec.)

LEADERSHIP
- ☐ Industrial Foremanship
- ☐ Industrial Supervision
- ☐ Personnel-Labor Relations
- ☐ Supervision

Name_____ Age____ Home Address_____

City_____ Zone____ State_____ Working Hours____ A.M. to____ P.M.____

Occupation_____

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.

IN JUST SIX MONTHS...

WOLVERINE

by Electro-Voice

HAS WON UNIVERSAL ACCLAIM FROM THE EXPERTS AS THE GREATEST VALUE IN HIGH FIDELITY

HERE'S WHY!

- First, regardless of your budget or the space you have available, whether you want monaural high fidelity or true stereo, there is a Wolverine enclosure and speaker system that will meet your needs . . . AND AT A PRICE YOU CAN AFFORD!
- Second, only Wolverine gives you features found in speakers and enclosures costing two and three times more.

YOU CAN CHOOSE FROM . . .

- Three handsome, acoustically-correct enclosures . . . for the corner, for along the wall, for shelf or bookcase.
- Two full-range loudspeakers — eight-inch and twelve-inch.
- Two convenient, easily-installed Step-Up Kits that let you expand your high-fidelity system now . . . or later.

CHOOSE FROM 2 SUPERB FULL-RANGE LOUDSPEAKERS...

Model LS12 12-inch

Response 30 to 13,000 cps; EIA sensitivity rating 43 db. Power-handling capacity 20 watts program, 40 watts peak. Impedance 8 ohms. Mechanical crossover 1800 cps. 12¼" dia., 3½" deep; 11" baffle opening. Net wgt. 5½ lbs. Audiophile net, $19.50.

Model LS8 8-inch

Response 50 to 13,000 cps; EIA sensitivity rating 42 db. Power-handling capacity 20 watts program, 40 watts peak. Impedance 8 ohms. Mechanical crossover 2000 cps. 8⅜" dia., 3½" deep; 7½" baffle opening. Net wgt. 4 lbs. Audiophile net, $18.00.

WITH ALL THESE FEATURES:

Heavy-Duty Diecast Frames—The hallmark of fine loudspeakers. Frames are heavy and rigid, holding the speaker cone and the delicate voice coil in exact center position without danger when the speaker is bolted to the cabinet.

Radax Construction—Two cones divide the sound, one for maximum bass reproduction and a second, smaller cone for efficient high-frequency performance. Clean, crisp highs are produced well beyond the point where conventional speakers fail.

Edgewise-Wound Voice Coil—Voice coils are edge-wound from precision, flattened ribbon conductor; efficiency is increased 18% over conventional round-wire coils, gaining the equivalent of five extra watts from a typical amplifier.

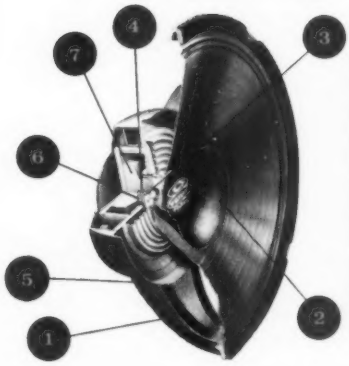
Glass Coil Form—The voice coil is wound on a fiberglas form into a rigid, concentric assembly. This exclusive assembly maintains shape for the life of the speaker system, permanently preventing shorts and distortion-causing rubs.

Long-Throw Voice Coil—Wolverine speakers contain deep, medium-diameter voice coils. Conductor remains in the air gap even on longest excursions, preventing nonlinear operation characteristic of wide-diameter, short-throw coils.

Slug-Type Magnet—Long accepted as the most efficient, slug-type magnets have the lowest leakage and greatest structural strength.

Low-Silhouette Frame—Wolverine speakers are only 3½" deep for easy mounting in walls or ceilings. Ideal for "built-in sound" throughout the home.

COMPARE ALL FIVE LOUDSPEAKERS



		WOLVERINE	SPEAKER A	SPEAKER B	SPEAKER C	SPEAKER D
1	Die Cast Frame	Yes	No	No	No	Yes
2	Radax Cone	Yes	No	No	Yes	No
3	Edgewise-Wound Voice Coil	Yes	No	No	No	Yes
4	Glass Coil Form	Yes	No	No	No	No
5	Low-Silhouette Frame	Yes	No	No	No	Yes
6	Long-Throw Voice Coil	Yes	Yes	Yes	Yes	No
7	Slug-Type Magnet	Yes	Yes	Yes	No	Yes
	NET PRICE	LS 12 $19.50 LS 8 $18.00	$23.75	$19.50	$33.00	$59.40

For the corner . . .

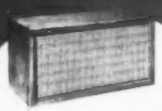
THE LORAINE

A corner-horn enclosure, the Loraine employs a corner of the room to reinforce and extend the bass range. For 12" speakers. Has pre-cut ports for adding HFI and MFI Step-Up-Kits . . . HWD 27" X 20" X 14" Audiophile Net **$48.00**

For along the wall . . .

THE LANCASTER

Handsome and functional direct radiator enclosure for 12" speakers. Has pre-cut ports for HFI and MFI Step-Up-Kits. Finished on four sides for high-boy or low-boy use. HWD, 25" X 20" X 14" Audiophile Net **$48.00**



For shelf or bookcase . . .

THE LINDON

Direct radiator enclosure for 8" speakers. Excellent for use in stereo pairs. Has pre-cut port for addition of HFI Step-Up-Kit. HWD, 11" X 23½" X 10" Audiophile Net **$34.50**

EXPAND YOUR HIGH-FIDELITY SYSTEM WITH WOLVERINE SET-UP KITS

STEP 1 . . . Add the Model HF-1 High-Frequency Step-Up Kit. Can be added to all Wolverine full-range loudspeakers. Extends high-frequency performance beyond the limits of audibility, for silky, precise definition of string and woodwind instruments. Consists of VHF driver and crossover network with built-in level control. Complete with all wiring, mounting hardware and instructions for simple, 5-minute installation.
Audiophile Net, $20.00

STEP 2 . . . Add the Model MF-1 Mid-Range Step-Up Kit. Can be added to Wolverine speakers after the HF-1 Step-Up Kit is installed. Spreads mid-range sound evenly throughout the room, increases output in the vital "presence" range, consists of treble driver and crossover network with built-in level control. Complete with all wiring, mounting hardware and instructions for simple, 5-minute installation.
Audiophile Net, $25.00

Perfect for Monaural, Perfect for Stereo

Whether starting from scratch or converting to stereo, the Wolverine series will meet your demand for full-range quality sound . . . and at a price 40% below comparable components. Compare the sound, compare the price, and you too will choose Wolverine by Electro-Voice.

See your Wolverine high-fidelity specialist.

For additional information, write Dept. 109-E

Electro-Voice® Inc.,

Buchanan, Michigan

Superb new products through research.

How to keep your profits from going to the "dogs"!

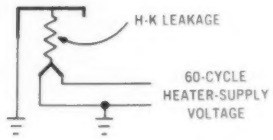
Another way RCA helps you improve your business.

STOP PROFIT LEAKS!

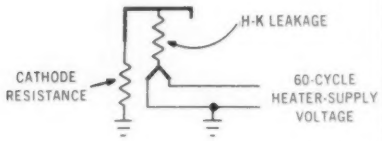
Review these important facts about heater-cathode leakage

Did that TV set come back? Same symptoms—60-cycle hum bars? You diagnosed the trouble correctly—a leaky tube.

Here's why a leaky tube can cause you a lot of trouble.

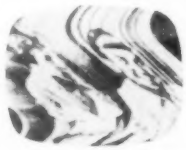


H-K leakage provides a path for 60-cycle current to flow from the heater to the cathode. If there is no resistance or impedance in the cathode circuit, this leakage current usually causes no difficulty.

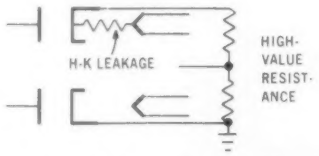


When there is resistance in the cathode circuit, the H-K leakage current develops a 60-cycle voltage across the cathode resistor. This voltage may produce visible and/or audible 60-cycle "hum".

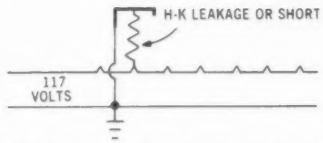
H-K leakage in the RF, IF, or video stages of a TV receiver can produce 60-cycle horizontal pulling and "hum" bars.



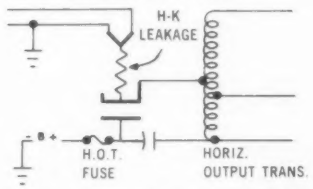
H-K leakage in the sync-separator tube or in the horizontal AFC, oscillator, or output tubes can produce 60-cycle horizontal pulling without "hum" bars.



In detector, discriminator, and AFC stages, which usually have relatively high values of resistance in the cathode circuit, even a slight amount of H-K leakage current can easily cause visible and/or audible 60-cycle "hum" symptoms.

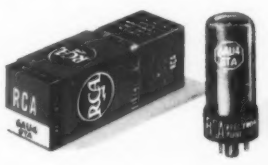


An H-K short circuit, or low-resistance leakage, in a series-string tube, short-circuits part of the heater circuit. The resulting higher voltage across the remaining heaters may cause heater burnout.



H-K leakage in a damper tube which has its heater grounded may cause the H.O.T. fuse to blow.

RCA tubes help you beat these problems—drastically reduce heater-cathode leakage and shorts through such improvements as precise control of heater coatings to eliminate "thin spots"...better heater stem lead arrangements...new cathode materials and structures. Avoid callbacks caused by tubes that develop H-K leakage problems and keep your profits from "leaking" too. Remember to always ask your distributor for *RCA TUBES!*



RADIO CORPORATION OF AMERICA

Electron Tube Division — *Harrison, N. J.*